

City of San Diego

CONTRACTOR'S NAME: NEWest Construction Company, Inc.
ADDRESS: 9235 Trade Place, Suite A, San Diego, CA 92126
TELEPHONE NO.: 858-537-0774 ext. 201 **FAX NO.:** 858-537-9653
CITY CONTACT: Brittany Friedenreich, Contract Specialist, Email: BFriedenreic@sandiego.gov
Phone No. (619) 533-3104
E. Fordan / R.W. Bustamante / ss

BIDDING DOCUMENTS



FOR

SOLEDAD PUMP STATION UPGRADES

BID NO.: K-18-1739-DBB-3
SAP NO. (WBS/IO/CC): B-11072
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 1
PROJECT TYPE: BJ, KA

THIS CONTRACT WILL BE 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
MARCH 27, 2018
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
525 B Street, Suite 750, MS 908A
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:

Eric B Magee
1) Registered Engineer

2/7/18
Date

Seal:



Debbie M. Van Martin
2) For City Engineer

2/7/2018
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 Soledad Pump Station Upgrades. 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 **\$6,900,000**.
4. **BID DUE DATE AND TIME ARE: March 27, 2018 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 is required for this contract: **B**.
7. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** Subcontracting participation percentages apply to this contract.
 - 7.1. 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	7.9%
2. ELBE participation	14.4%
3. Total mandatory participation	22.3%
 - 7.2. The Bid may be declared non-responsive if the Bidder fails to meet the following requirements:
 - 7.2.1. Include SLBE-ELBE certified subcontractors at the overall mandatory participation percentage identified in this document; **OR**
 - 7.2.2. Submit 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. AWARD PROCESS:

- 8.1.** 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.
- 8.2.** Upon acceptance of bids and determination of the apparent low bidder, the City will prepare the contract documents for execution within approximately 21 days of the date of the bid opening. The City will then award the contract upon receipt of properly signed Contract, bonds, and insurance documents.
- 8.3.** 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 by the City Attorney's Office.
- 8.4.** The low Bid will be determined by Base Bid alone.
- 10.5** Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base bid alone.

9. SUBMISSION OF QUESTIONS:

- 9.1.** The Director (or Designee) of the Public Works Department is 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. Any questions related to this solicitation shall be submitted to:

Public Works Contracts
525 B Street, Suite 750, MS 908A
SAN DIEGO, CA 92101
Attention: Brittany Friedenreich

OR:

BFriedenreic@sandiego.gov

- 9.2.** Questions received less than 14 days prior to the date for opening of Bids may not be considered.
- 9.3.** 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.
- 9.4.** 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.

10. 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.
- 1.3. Due to the City's responsibility to protect the confidentiality of the contractors' information, 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 an 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, EOCB 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 on 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 7-6, “The Contractors Representative” in The GREENBOOK and 7-6.1 in The WHITEBOOK.
- 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”) http://www.greenbookspecs.org/	2015	PWPI070116-01
City of San Diego Standard Specifications for Public Works Construction (“The WHITEBOOK”)* https://www.sandiego.gov/publicworks/edocref/greenbook	2015	PWPI070116-02
City of San Diego Standard Drawings* https://www.sandiego.gov/publicworks/edocref/standarddraw	2016	PWPI070116-03
Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/publicworks/edocref/drawings	2016	PWPI092816-04
California Department of Transportation (CALTRANS) Standard Specifications – http://www.dot.ca.gov/des/oe/construction-contract-standards.html	2015	PWPI092816-05
CALTRANS Standard Plans http://www.dot.ca.gov/des/oe/construction-contract-standards.html	2015	PWPI092816-06
California Manual on Uniform Traffic Control Devices Revision 1 (CA MUTCD Rev 1) - http://www.dot.ca.gov/trafficops/camutcd/	2014	PWPI092816-07
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 addenda 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 state the **DIR REGISTRATION NUMBER** for all subcontractors and 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), DIR REGISTRATION NUMBER** 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:**
- 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 ACCEPTED:** 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) FOR DESIGN-BID-BUILD CONTRACTS:

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 Drug-Free 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 Contractor Standards.
- 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 **non-responsive**.
- 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:

NEWest Construction Company, Inc. _____, a corporation, as principal, and Arch 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 **Six Million Eight Hundred Eighty Nine Thousand Seven Hundred Sixty Dollars and Zero Cents (\$6,889,760.00)** for the faithful performance of the annexed contract, and in the sum of **Six Million Eight Hundred Eighty Nine Thousand Seven Hundred Sixty Dollars and Zero Cents (\$6,889,760.00)** 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, California, 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.

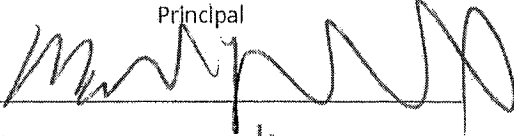
PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

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

Dated April 5, 2018

Approved as to Form

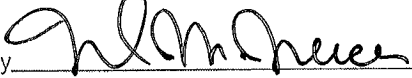
NEWest Construction Co., Inc.

Principal
By 

Mark Jenette

Printed Name of Person Signing for Principal

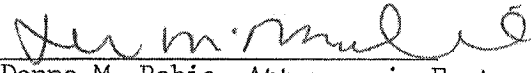
Mara W. Elliott, City Attorney

By 

Deputy City Attorney

Arch Insurance Company

Surety

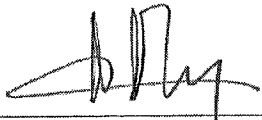
By 

Donna M. Robie, Attorney-in-Fact
Attorney-in-fact

Jere Keprios
c/o C T Corporation System
818 West Seventh Street, 2nd Floor

Local Address of Surety

Approved:

By 

Albert Rechany
Deputy Director
Public Works Contracts

Los Angeles, CA 90017

Local Address (City, State) of Surety

213-627-8252

Local Telephone No. of Surety

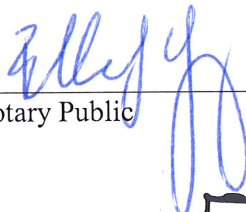
Premium \$ 52,080.00

Bond No. SU1140490

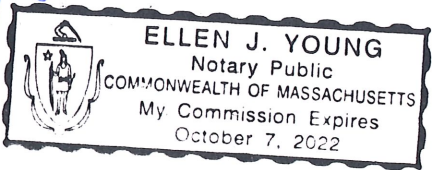
SURETY ACKNOWLEDGMENT

State of: Massachusetts
County of: Middlesex

On this 5th day of April, 2018 before me personally came Donna M. Robie to me known, who, being by me duly sworn, did depose and say that he/she resides at Natick, Massachusetts that he/she is the Attorney-in-fact for Arch Insurance Company the corporation described in and which executed the foregoing instrument; that he/she knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors or said corporation, and that he/she signed his/ her name thereto by like order.



Notary Public



THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON BLUE 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. Not valid for Mortgage, Note, Loan, Letter of Credit, Bank Deposit, Currency Rate, Interest Rate or Residential Value Guarantees.

POWER OF ATTORNEY

Know All Persons By These Presents:

That the Arch Insurance Company, a corporation organized and existing under the laws of the State of Missouri, having its principal administrative office in Jersey City, New Jersey (hereinafter referred to as the "Company") does hereby appoint:

Donna M. Robie, Ellen J. Young and Frank J. Smith of Natick, MA (EACH)

its true and lawful Attorney(s)in-Fact, to make, execute, seal, and deliver from the date of issuance of this power for and on its behalf as surety, and as its act and deed:

Any and all bonds, undertakings, recognizances and other surety obligations, in the penal sum not exceeding Ninety Million Dollars (\$90,000,000.00).

This authority does not permit the same obligation to be split into two or more bonds In order to bring each such bond within the dollar limit of authority as set forth herein.

The execution of such bonds, undertakings, recognizances and other surety obligations in pursuance of these presents shall be as binding upon the said Company as fully and amply to all intents and purposes, as if the same had been duly executed and acknowledged by its regularly elected officers at its principal administrative office in Jersey City, New Jersey.

This Power of Attorney is executed by authority of resolutions adopted by unanimous consent of the Board of Directors of the Company on September 15, 2011, true and accurate copies of which are hereinafter set forth and are hereby certified to by the undersigned Secretary as being in full force and effect:

"VOTED, That the Chairman of the Board, the President, or the Executive Vice President, or any Senior Vice President, of the Surety Business Division, or their appointees designated in writing and filed with the Secretary, or the Secretary shall have the power and authority to appoint agents and attorneys-in-fact, and to authorize them subject to the limitations set forth in their respective powers of attorney, to execute on behalf of the Company, and attach the seal of the Company thereto, bonds, undertakings, recognizances and other surety obligations obligatory in the nature thereof, and any such officers of the Company may appoint agents for acceptance of process."

This Power of Attorney is signed, sealed and certified by facsimile under and by authority of the following resolution adopted by the unanimous consent of the Board of Directors of the Company on September 15, 2011:

VOTED, That the signature of the Chairman of the Board, the President, or the Executive Vice President, or any Senior Vice President, of the Surety Business Division, or their appointees designated in writing and filed with the Secretary, and the signature of the Secretary, the seal of the Company, and certifications by the Secretary, may be affixed by facsimile on any power of attorney or bond executed pursuant to the resolution adopted by the Board of Directors on September 15, 2011, and any such power so executed, sealed and certified with respect to any bond or undertaking to which it is attached, shall continue to be valid and binding upon the Company.

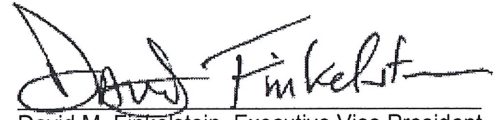
In Testimony Whereof, the Company has caused this instrument to be signed and its corporate seal to be affixed by their authorized officers, this 12th day of July, 2017.

Attested and Certified

Arch Insurance Company


Patrick K. Nails, Secretary

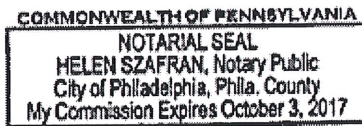


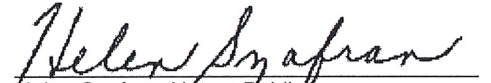

David M. Finkelstein, Executive Vice President

STATE OF PENNSYLVANIA SS

COUNTY OF PHILADELPHIA SS

I, Helen Szafran, a Notary Public, do hereby certify that Patrick K. Nails and David M. Finkelstein personally known to me to be the same persons whose names are respectively as Secretary and Executive Vice President of the Arch Insurance Company, a Corporation organized and existing under the laws of the State of Missouri, subscribed to the foregoing instrument, appeared before me this day in person and severally acknowledged that they being thereunto duly authorized signed, sealed with the corporate seal and delivered the said instrument as the free and voluntary act of said corporation and as their own free and voluntary acts for the uses and purposes therein set forth.

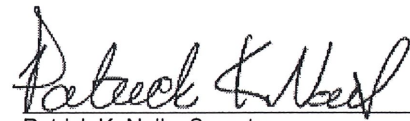



Helen Szafran, Notary Public
My commission expires 10/03/2017

CERTIFICATION

I, Patrick K. Nails, Secretary of the Arch Insurance Company, do hereby certify that the attached Power of Attorney dated July 12, 2017 on behalf of the person(s) as listed above is a true and correct copy and that the same has been in full force and effect since the date thereof and is in full force and effect on the date of this certificate; and I do further certify that the said David M. Finkelstein, who executed the Power of Attorney as Executive Vice President, was on the date of execution of the attached Power of Attorney the duly elected Executive Vice President of the Arch Insurance Company.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seal of the Arch Insurance Company on this 5th day of April, 20 18.


Patrick K. Nails, Secretary

This Power of Attorney limits the acts of those named therein to the bonds and undertakings specifically named therein and they have no authority to bind the Company except in the manner and to the extent herein stated.

PLEASE SEND ALL CLAIM INQUIRIES RELATING TO THIS BOND TO THE FOLLOWING ADDRESS:

Arch Insurance – Surety Division
3 Parkway, Suite 1500
Philadelphia, PA 19102



ATTACHMENTS

ATTACHMENT A
SCOPE OF WORK

SCOPE OF WORK

- 1. SCOPE OF WORK:** The Soledad Pump Station project proposes the construction of a new 1,387 square foot (SF) pump station building, inlet/outlet piping, tank mixing system, landscaping, miscellaneous pump station upgrades, electrical work, street resurfacing, and site resurfacing.
 - 1.1.** The Work shall be performed in accordance with:
 - 1.1.1.** The Notice Inviting Bids and Plans numbered **38309-1-D** through **38309-122-D**, inclusive.
- 2. LOCATION OF WORK:** The location of the Work is as follows:

6751 1/3 La Jolla Scenic South Drive, La Jolla, CA 92037
- 3. CONTRACT TIME:** The Contract Time for completion of the Work, including the Plant Establishment Period, shall be **380 Working Days**.

ATTACHMENT B
PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PRE-AWARD

- 1.1. Within 10 Working Days after the Bid Opening date, the Apparent Low Bidder must contact the Project Manager to discuss fund availability for each phase and shall also submit the following:
 - 1.1.1. Construction Cost Loaded Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 9-3, "PAYMENT.
- 1.2. Your failure to perform any of the following may result cancelling your award of the Contract:
 - 1.2.1. Meeting with the City's Project Manager to discuss the Phased Funding Schedule.
 - 1.2.2. Agreeing to a Phased Funding Schedule within **thirty** Working Days after meeting with the City's Project Manager.

2. POST-AWARD

- 2.1. Do not start any construction activities for the next phase until the NTP has been issued by the Engineer. The City will issue separate Notice to Proceed (NTP) documents for each phase.
- 2.2. If requested, the Engineer may issue the NTP for the next phase before the end of the current approved phase.

PHASED FUNDING SCHEDULE AGREEMENT

BID NUMBER: K-18-1739-DBB-3

CONTRACT OR TASK TITLE: Soledad Pump Station Upgrades

CONTRACTOR: NEWest Construction Company, Inc.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	Bonding, mobilization, construction start-up and pump station building	NTP	January 16, 2019	\$2,500,000.00
2	Pumps, yard piping, tank improvements and mixing system, surge tank, site improvements and landscaping, electrical and motor control systems, security system, demobilization and all other work shown on the plans and specifications	January 16, 2019	NOC	\$4,389,760.00
Contract Total				\$6,889,760.00

Notes:

- 1) WHITEBOOK section 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 written modifications to the CONTRACT.

CITY OF SAN DIEGO

CONTRACTOR

PRINT NAME: Steve Lindsay
Construction Manager

PRINT NAME: Mark Jennette

Signature: [Signature]
Date: 4/16/18

Title: Project Manager
Signature: [Signature]
Date: 4/12/2018

PRINT NAME: Ed Fordan
Project Manager

Signature: [Signature]
Date: 4/16/18

ATTACHMENT C

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ATTACHMENT D
PREVAILING WAGES

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. This

shall be in addition to any other applicable penalties allowed under Labor Code sections 1720 – 1861.

- 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.** Contractor and their subcontractors shall also 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 contractors 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 sections 1810 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. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid or proposal, subject to the requirements of section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.
- 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.
- 1.9.2.** 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 for themselves and all listed subcontractors to the City at the time of bid or proposal due date or upon request.
- 1.10. Stop Order.** For Contractor or its subcontractors engaging in the performance of any public work contract without having been registered in violation of Labor Code sections 1725.5 or 1771.1, the Labor Commissioner shall issue and serve a stop order prohibiting the use of the unregistered contractors or unregistered subcontractor(s) on ALL public works until the unregistered contractor or unregistered subcontractor(s) is registered. Failure to observe a stop order is a misdemeanor.
- 1.11. List of all Subcontractors.** The City may ask Contractor for the most current list of subcontractors (regardless of tier), along with their DIR registration numbers, utilized on this Agreement at any time during performance of this contract, and Contractor shall

provide the list within ten (10) working days of the City's request. Additionally, Contractor shall provide the City with a complete list of all subcontractors utilized on this contract (regardless of tier), within ten working days of the completion of the contract, along with their DIR registration numbers. The City shall withhold final payment to Contractor until at least 30 days after this information is provided to the City.

1.12. Exemptions for Small Projects. There are limited exemptions for installation, alteration, demolition, or repair work done on projects of \$25,000 or less. The Contractor shall still comply with Labor Code sections 1720 et. seq. The only recognized exemptions are listed below:

1.12.1. Registration. The Contractor will not be required to register with the DIR for small projects. (Labor Code section 1771.1)

1.12.2. Certified Payroll Records. The records required in Labor Code section 1776 shall be required to be kept and submitted to the City of San Diego, but will not be required to be submitted online with the DIR directly. The Contractor will need to keep those records for at least three years following the completion of the Contract. (Labor Code section 1771.4).

1.12.3. List of all Subcontractors. The Contractor shall not be required to hire only registered subcontractors and is exempt from submitting the list of all subcontractors that is required in section 4.20.11 above. (Labor code section 1773.3).

ATTACHMENT E
SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

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

1. The **2015 Edition** of the Standard Specifications for Public Works Construction (The "GREENBOOK").
2. The **2015 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK"), including the following:
 - a) General Provisions (A) for all Contracts.

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

- 1-2 TERMS AND DEFINITIONS.** To the "WHITEBOOK", item 54, "Normal Working Hours", ADD the following:

The **Normal Working Hours** are **7:30 AM** to **4:00 PM**.

SECTION 2 - SCOPE AND CONTROL OF WORK

- 2-3.2 Self Performance.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The self performance percentage requirement will be waived for Prime Contractors meeting the **Class B** License requirement of this Contract.

- 2-5.3.4 Supporting Information.** To the "WHITEBOOK", ADD the following:

2. For landscaping and irrigation materials, submit samples and test results to the Engineer within 15 Days of the NTP.

- 2-7 SUBSURFACE DATA.** To the "WHITEBOOK", 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:
 - a) Report of Geotechnical Investigation Soledad Pump Station Replacement 6751 La Jolla Scenic Drive, La Jolla, California dated June 15, 2015 by Allied Geotechnical Engineers, Inc.

5. The reports listed above are available for review by contacting the Contract Specialist or referring to **Appendix I**.

**ADD:
2-10**

AUTHORITY OF THE BOARD AND THE ENGINEER. To the "GREENBOOK", Paragraph (2), DELETE in its entirety and SUBSTITUTE with the following:

The decision of the Engineer is final and binding on all questions relating to: quantities; acceptability of material, equipment, or work; execution, progress or sequence of work; requests for information (RFI), and interpretation of the Plans, Specifications, or other Contract Documents. This shall be precedent to any payment under the Contract. The Engineer shall be the single point of contact and shall be included in all communications.

2-14.3

Coordination. To the "WHITEBOOK", ADD the following:

2. Other adjacent City projects are scheduled for construction for the same time period in the vicinity of **La Jolla Scenic Drive South (S-12009) and La Jolla Country Club Reservoir (S-15027)**. See **Appendix E** for the approximate location. Coordinate the Work with the adjacent projects as listed below:

- a) La Jolla Scenic Drive Pipeline Project (S-12009 & B-15176). Project Manager is Michael Ninh at 619-533-7443
- b) La Jolla Country Club Reservoir (S-15027). Project manager is Debbie Van Martin 619-533-6651. The Soledad Pump Station shall not be taken offline until the La Jolla Country Club Reservoir and Pump Station are completed and online. Other portions of work may proceed providing it does not interfere with Soledad Reservoir and Pump Station operations.

Before the Soledad Reservoir and Pump Station can be scheduled offline from service, The City Public Utility Department shall have diesel powered pumps on standby in case of a large fire.

3. Coordination of Water Service Shutdowns shall be with the following:
 - a) TC Construction, Elan Schier – 619-448-4560 ext. 141
 - b) NEWest Construction Co., Mark Jennette – 858-0774 ext. 201

2-15

TECHNICAL STUDIES AND DATA. To the "WHITEBOOK", ADD the following:

3. In preparation of the Contract Documents, the designer has relied upon the following reports of explorations and tests at the Work Site:
 - a) Noise Evaluation for Mt. Soledad Pump Station Project in San Diego CA by LDN Consulting, Inc. dated August 23, 2016

4. The reports listed above are available for review by contacting the Contract Specialist or referring to **Appendix J**.

2-16 **CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM.** To the "WHITEBOOK", item 1, DELETE in its entirety.

SECTION 3 – CHANGES IN WORK

3-5.1 **Claims.** To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

ADD:

3-5.1

Claims.

1. A Claim is a written demand by you that seeks an adjustment in the Contract Price, Contract Time, or other relief associated with a dispute arising under or relating to the Contract, including a breach of any provision thereof. A voucher, invoice, or other routine request for payment is not a Claim.
2. A Claim shall conform to these specifications and may be considered after the City has previously denied a request by you for a Change Order seeking the demanded relief.
3. You shall submit a Claim to the Engineer if a dispute occurs that arises from or relates to the Contract. The Claim shall seek all relief to which you assert you are entitled as a result of the event(s) giving rise to the dispute. Your failure to process a Claim in accordance with these specifications shall constitute a waiver of all relief associated with the dispute. Claims are subject to 6-11, "Right to Audit".
4. You shall continue to perform the Services and Work and shall maintain the Schedule during any dispute proceedings. The Engineer will continue to make payments for undisputed Services and Work.
5. The City's Claims process specified herein shall not relieve you of your statutory obligations to present claims prior to any action under the California Government Code.

3-5.1.1

Initiation of Claim.

1. You shall promptly, but no later than 30 Days after the event(s) giving rise to the Claim, deliver the Claim to the Engineer.
2. You shall not process a Claim unless the Engineer has previously denied a request by you for a Change Order that sought the relief to be pursued in the claim.

3-5.1.1.1 Claim Certification Submittal.

1. If your Claim seeks an increase in the Contract Price, the Contract Time, or both, submit with the Claim an affidavit certifying the following:
 - a) The Claim is made in good faith and covers all costs and delays to which you are entitled as a result of the event(s) giving rise to the Claim.
 - b) The amount claimed accurately reflects the adjustments in the Contract Price, the Contract Time, or both to which you believe you are entitled.
 - c) All supporting costs and pricing data are current, accurate, and complete to the best of your knowledge. The cost breakdown per item of Work shall be supplied.
 - d) You shall ensure that the affidavit is executed by an official who has the authority to legally bind you.

3-5.1.2 Initial Determination.

1. The Engineer will respond in writing to your Claim within 30 Days of receipt of the Claim.

3-5.1.3 Settlement Meeting.

1. If you disagree with the Initial Determination, you shall request a Settlement Meeting within 30 Days. Upon receipt of this request, the Engineer will schedule the Settlement Meeting within 15 Working Days.

3-5.1.4 City's Final Determination.

1. If a settle agreement is not reached, the City shall make a written Final Determination within 10 Working Days after the Settlement Meeting.
2. If you disagree with the City's Final Determination, notify the Engineer in writing of your objection within 15 Working Days after receipt of the written determination and file a "Request for Mediation" in accordance with 3-5.2, "Dispute Resolution Process".
3. Failure to give notice of objection within the 15 Working Days period shall waive your right to pursue the Claim.

3-5.1.5 Mandatory Assistance.

1. If a third party dispute, litigation, or both arises out of or relates in any way to the Services provided under the Contract, upon the City's request, you shall agree to assist in resolving the dispute or litigation. Your assistance includes, but is not limited to the following:
 - a) Providing professional consultations.

- b) Attending mediations, arbitrations, depositions, trials, or any event related to the dispute resolution and litigation.

3-5.1.5.1 Compensation for Mandatory Assistance.

1. The City will reimburse you for reasonable fees and expenses incurred by you for any required assistance rendered in accordance with 3-5.1.8, "Mandatory Assistance" as Extra Work.
2. The Engineer will determine whether these fees and expenses were necessary due to your conduct or failure to act.
3. If the Engineer determines that the basis of the dispute or litigation in which these fees and expenses were incurred were the result of your conduct or your failure to act in part or in whole, you shall reimburse the City for any payments made for these fees and expenses.
4. Reimbursement may be through any legal means necessary, including the City's withholding of your payment.

3-5.2.3 Selection of Mediator. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. A single mediator, knowledgeable in construction aspects and acceptable to both parties, shall be used to mediate the dispute.
2. To initiate mediation, the initiating party shall serve a Request for Mediation at the American Arbitration Association (AAA) on the opposing party.
3. If AAA is used, the initiating party shall concurrently file with AAA a "Request for Mediation" along with the appropriate fees, a copy of requested mediators marked in preference order, and a preference for available dates.
4. If AAA is selected to coordinate the mediation (Administrator), within 10 Working Days from the receipt of the initiating party's Request for Mediation, the opposing party shall file the following:
 - a) A copy of the list of the preferred mediators listed in preference order after striking any mediators to which they have any objection.
 - b) A preference for available dates.
 - c) Appropriate fees.
5. If the parties cannot agree on a mediator, then each party shall select a mediator and those mediators shall select the neutral third party to mediate the matter.

3-5.3 Forum of Litigation. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. It is the express intention that all legal actions and proceedings related to the Contract or Agreement with the City or to any rights or any relationship

between the parties arising therefrom shall be solely and exclusively initiated and maintained in courts of the State of California for the County of San Diego.

SECTION 4 - CONTROL OF MATERIALS

4-1.3.1 General. To the "WHITEBOOK", ADD the following:

1. Steel pipe in sizes larger than 18 inches shall require inspection at the source of production.
2. City lab staff or a qualified inspection agency approved by the Engineer shall witness all welding, lining, coating, and testing. You shall incur additional inspection costs outlined in 4-1.3.3, "Inspection of Items Not Locally Produced".
3. All parts of production (including but not limited to product fabrication, welding, testing, lining, and coating of straight pieces and specials) shall be performed or produced in the United States.
4. Welding and all testing shall be performed by certified welders and testing staff with credentials traceable in the United States.

4-1.3.2 Inspection by the Agency. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The City will provide inspection and testing laboratory services within the continental United States within a 200-mile radius of the geographical limits of the City.

4-1.3.3 Inspection of Items Not Locally Produced. To the "WHITEBOOK", DELETE in its entirety.

ADD:

4-1.3.3 Inspection of Items Not Locally Produced. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. When you intend to purchase materials, fabricated products, or equipment from sources located more than 200 miles (321.9 km) outside the geographical limits of the City, City Lab staff or a qualified inspection agency approved by the Engineer, shall be engaged at your expense to inspect the materials, equipment, or process.
2. This approval shall be obtained before producing any material or equipment. City Lab staff or inspector shall evaluate the materials for conformance with the requirements of the Plans and Specifications. You shall forward reports required by the Engineer. No materials or equipment shall be shipped nor shall any processing, fabrication or treatment of such materials be done without proper inspection by City Lab staff or the approved agent. Approval

by said agent shall not relieve you of responsibility for complying with the requirements of the Contract Documents.

3. The Engineer may elect City Lab staff to perform inspection of an out-of-town manufacturer. You shall incur additional inspection costs of the Engineer including lodging, meals, and incidental expenses based on Federal Per Diem Rates, along with travel and car rental expenses. If the manufacturing plant operates a double shift, a double shift shall be figured in the inspection costs.
 - a) At the option of the Engineer, full time inspection shall continue for the length of the manufacturing period. If the manufacturing period will exceed 3 consecutive weeks, you shall incur additional inspection expenses of the Engineer's supervisor for a trip of 2 Days to the site per month.
 - b) When the Engineer elects City Lab staff to perform out-of-town inspections, the wages of staff employed by the City shall not be part of the additional inspection expenses paid by you.
 - c) Federal Per Diem Rates can be determined at the location below:

<https://www.gsa.gov/portal/content/104877>

4-1.3.4 Inspection Paid For By the Contractor. To the "WHITEBOOK", ADD the following:

1. The special inspections required are listed as follows:
 - a) Welding Inspection
 - b) See Structural Drawings for more requirements

4-1.3.5 Special Inspection. To the "WHITEBOOK", ADD the following:

5. The payment for special inspection Work specified under this section shall be paid in accordance with 4-1.3.4.1, "Payment".

4-1.3.6 Preapproved Materials. To the "WHITEBOOK", 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. To the "WHITEBOOK", ADD the following:

11. You shall submit your list of proposed substitutions for an "equal" item **no less than 15 Working Days prior to the Bid due date** and on the City's Product Submittal Form available at:

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

SECTION 5 – UTILITIES

5-2 PROTECTION. To the “WHITEBOOK”, item 2, ADD the following:

- g) Refer to **Appendix G** for more information on the protection of AMI devices.

5-6 COOPERATION. To the “GREENBOOK”, ADD the following:

1. Notify SDG&E at least 10 Working Days prior to excavating within 10 feet of SDG&E Underground High Voltage Transmission Power Lines (69 KV and higher).
2. Coordinate with SDGE for removal/relocation of existing transformer and installation of new transformer.

SECTION 6 - PROSECUTION, PROGRESS AND ACCEPTANCE OF WORK

6-1.1 Construction Schedule. To the “WHITEBOOK”, item 20, ADD the following:

The **120 Calendar Days** for Plant Establishment Period is included in the stipulated Contract Time.

To the “WHITEBOOK”, item 22, subsection b, DELETE in its entirety and SUBSTITUTE with the following:

- b) A curve value percentage comparison between the Contract Price and the updated cash flow forecast for each Project ID included in the Contract Documents. Curve values shall be set on a scale from 0% to 100% in intervals of 5% of the Contract Time. Refer to the Sample City Invoice materials in the Contract Documents and use the format shown. Your invoice amounts shall be supported by this curve value percentage. For previous periods, use the actual values and percentages and update the curve value percentages accordingly.

ADD:

6-3.2.1.1 Environmental Document.

1. The City of San Diego has prepared a/an Notice of Exemption for **Soledad Pump Station Upgrades, Project No. B-11072** as referenced in the Contract Appendix. You shall comply with all requirements of the **Notice of Exemption** as set forth in **Appendix A**.
2. Compliance with the City's environmental document shall be included in the Contract Price.

6-7.1 General. To the "WHITEBOOK", item 3, ADD the following:

- d) 30 Days for full depth asphalt final mill and resurfacing work required per SDG-107.
- e) Where shutdowns of 16 inch and larger pipes are required, there is a shutdown moratorium from May until October. Plan and schedule Work accordingly. No additional payment or Working Days will be granted for delays due to the moratorium.

6-8.3 Warranty. To the "WHITEBOOK", item 1, DELETE in its entirety and SUBSTITUTE with the following:

- 1. Warranty and repair all defective materials and workmanship for a period of 1 year. This call back warranty period shall start on the date that the Work was accepted by the City. Additionally, you shall warranty the Work against all latent and patent defects for a period of 10 years.

SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

7-3 INSURANCE. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

7-3 INSURANCE.

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

7-3.1 Policies and Procedures.

- 1. You shall 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 shall 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. The payment for insurance shall be included in the Contract Price as bid by you. 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 shall 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 shall 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 shall 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 shall be no endorsement or modification limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. You shall maintain the same or equivalent insurance for at least 10 years following completion of the Work.
4. All costs of defense shall be outside the policy limits. Policy coverage shall be in liability limits of not less than the following:

<u>General Annual Aggregate Limit</u>	<u>Limits of Liability</u>
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 shall 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 shall be outside the limits of the policy.

7-3.2.3 Contractors Pollution Liability Insurance.

1. You shall procure and maintain at your expense or require your 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 shall be outside the limits of the policy. Any such insurance provided by your Subcontractor instead of you shall be approved separately in writing by the City.
3. For approval of a substitution of your Subcontractor's insurance, you shall 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 shall not exceed \$25,000 per claim.
4. Contractual liability shall include coverage of tort liability of another party to pay for bodily injury or property damage to a third person or organization. There shall 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 shall be procured before the Work commences and shall be maintained for the Contract Time. Claims Made policies shall be procured before the Work commences, shall be maintained for the Contract Time, and shall include a 12 month extended Claims Discovery Period applicable to this contract or the existing policy or policies that shall 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 shall 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 shall provide at your expense or require your 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 shall be outside the limits of the policy. The deductible shall not exceed \$25,000 per claim. Any such insurance provided by a subcontractor instead of you shall 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 shall include coverage of tort liability of another party to pay for bodily injury or property damage to a third person or organization. There shall 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 shall be procured before the Work commences and shall be maintained for the duration of this Contract. Claims Made policies shall be procured before the Work commences, shall be maintained for the duration of this contract, and shall include a 12 month extended Claims Discovery Period applicable to this contract or the existing policy or policies that shall 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 shall 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 shall provide at your expense, and maintain until Final Acceptance of the Work, a Special Form Builders Risk Policy or Policies. This insurance shall 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 shall be 100% of this Contract value of the

Work plus 15% to cover administrative costs, design costs, and the costs of inspections and construction management.

2. Insured property shall include material or portions of the Work located away from the Site but intended for use at the Site and shall cover material or portions of the Work in transit. The policy or policies shall include as insured property scaffolding, falsework, and temporary buildings located at the Site. The policy or policies shall cover the cost of removing debris, including demolition.
3. The policy or policies shall provide that all proceeds thereunder shall be payable to the City as Trustee for the insured, and shall name the City, the Contractor, Subcontractors, and Suppliers of all tiers as named insured. The City, 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 shall 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 shall 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 shall 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 shall be entitled to 100% of its loss. You shall 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 shall be responsible for 100% of the loss not insured because of the deductible. Except as provided for under California law, the policy or policies shall 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 shall 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 shall 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 shall 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.

1. You shall 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.
2. To the fullest extent allowed by law e.g., California Insurance Code §11580.04, the policy shall be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured.
3. The additional insured coverage for projects for which the Engineer's Estimate is \$1,000,000 or more shall 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.
4. The additional insured coverage for projects for which the Engineer's Estimate is less than \$1,000,000 shall 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 shall 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 shall provide that any insurance maintained by the City and its elected

officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

7-3.5.1.3 Project General Aggregate Limit. The policy or policies shall 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 shall reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit shall 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 shall 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.

1. The policy or policies shall 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 shall 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.

2. 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 are 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 shall 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 shall 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 shall be in excess of your insurance and shall not contribute to it.

7-3.5.3.3 Severability of Interest. For Contractors Pollution Liability Insurance, the policy or policies shall provide that your insurance shall 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 shall provide cross-liability coverage.

7-3.5.4 Contractors Hazardous Transporters Pollution Liability Insurance Endorsements.

7-3.5.4.1 Additional Insured.

1. The policy or policies shall 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 shall 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.

2. 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 are 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 shall 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 shall 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 shall be in excess of your insurance and shall not contribute to it.

7-3.5.4.3 Severability of Interest. For Contractors Hazardous Transporters Pollution Liability Insurance, the policy or policies shall provide that your insurance shall 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 shall provide cross-liability coverage.

7-3.5.5 Builders Risk Endorsements.

7-3.5.5.1 Waiver of Subrogation. The policy or policies shall 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 desires 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 shall immediately notify your Builder's Risk insurer and obtain an endorsement that the policy or policies shall not be cancelled or lapse on account of any such partial use or occupancy. You shall obtain the endorsement prior to the City's occupation and use.

7-3.6 Deductibles and Self-Insured Retentions. You shall pay for all deductibles and self-insured retentions. You shall 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 shall 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 shall 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), and etc.) by you, you shall keep or require all of your employees or Subcontractors, who provide professional engineering services under this contract, Professional Liability coverage with a limit of **\$1,000,000** per claim and **\$2,000,000** annual aggregate in full force and effect.
2. You shall ensure the following:
 - a) The policy retroactive date is on or before the date of commencement of the Project.
 - 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 shall:
 - 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 NOT USED. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

7-4 WORKERS' COMPENSATION INSURANCE AND EMPLOYERS LIABILITY INSURANCE.

1. In accordance with the provisions of §3700 of the California Labor Code, you shall 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 shall be not less than the following:

<u>Workers' Compensation</u>	<u>Statutory Employers Liability</u>
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 requires 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 shall comply with such provisions before commencing the Work as required by §1861 of the California Labor Code.

7-4.1 Waiver of Subrogation. The policy or policies shall 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 "WHITEBOOK", ADD the following:

2. The City will obtain, at no cost to you, the following permits:
 - a) Building and Water Service permit shall be pulled by Contractor.

ADD:

7-6 THE CONTRACTORS REPRESENTATIVE. To the "GREENBOOK", ADD the following:

1. Both the representative and alternative representative shall be employees of the Contractor and shall not be assigned to a Subcontractor unless otherwise approved by the City in writing.

7-8.1 General. To the "WHITEBOOK", ADD the following:

2. Use a PM-10 certified self-loading motorized street sweeper equipped with a functional water spray system for this project as directed by the Engineer.

7-8.6 Water Pollution Control. To the "WHITEBOOK", ADD the following:

6. Based on a preliminary assessment by the City, this Contract is subject to **WPCP**.

7-8.6.5.1 Payment. To the "WHITEBOOK", DELETE in its entirety.

ADD:

7-8.6.5.1 Chlorination Discharge Requirements.

1. If prior approval is obtained to discharge to the sewer system, you shall discharge the chlorinated water used for testing and acceptance of new water mains to the sewer system in accordance with the Contract Documents after de-chlorination as shown on the batch discharge Plans. You shall submit to the Engineer a "Request for Batch Discharge Authorization to Discharge Potable Pipe Flushing Water to Sewer" form. The request form is found on the City website at the following location:

https://www.sandiego.gov/sites/default/files/batch_discharge_authorization_request_1.pdf

2. When discharging to the sewer system has been approved, you shall use a totalizer flow meter to record the total volume discharged to sewer and shall submit to the Engineer a log of actual discharged water quantities, dates, and locations. Failure to report this information to the Engineer is a violation of the authorization for discharge to the sanitary sewer. Within five (5) Working Days of the discharge, the Engineer shall report actual total flows to the sanitary sewer to the Public Utilities Department (PUD), Industrial Wastewater Control Program (IWCP).

3. If the discharge to the sewer system is not approved, you shall discharge the chlorinated water used for the testing of new mains to surface waters, storm drain inlets, or to other approved sources and you shall comply with 7-8.6.5, "Hydrostatic Discharge Requirements". All discharge activities related to the project shall comply with the State Water Resources Control Board, ORDER WQ 2014-0194-DWQ, STATEWIDE GENERAL NPDES PERMIT FOR DRINKING WATER SYSTEMS DISCHARGES as referenced by:

http://www.waterboards.ca.gov/water_issues/programs/npdes/docs/drinking_water/final_statewide_wqo2014_0194_dwq.pdf

All testing shall be conducted by a QSP.

ADD:

7-8.6.5.2

Payment.

1. The payment for complying with the discharge requirements shall be included in the Bid item for the new water main.

7-13.4

Contractor Standards and Pledge of Compliance. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The Contract is subject to City's Municipal Code §22.3004 as amended 10/29/13 by ordinance O-20316.
2. You shall complete a Pledge of Compliance attesting under penalty of perjury that you complied with the requirements of this section.
3. You shall ensure that all Subcontractors complete a Pledge of Compliance attesting under penalty of perjury that they complied with the requirements of this section.
4. You may access the Pledge of Compliance at:

http://www.sandiego.gov/purchasing/pdf/contractor_standards_questionnaire.pdf

5. You shall require in each subcontract that the Subcontractor shall abide by the provisions of the City's Municipal Code §22.3004. A sample provision is as follows:

"Compliance with San Diego Municipal Code §22.3004: The Subcontractor acknowledges that it is familiar with the requirements of San Diego Municipal Code §22.3004 ("Contractor Standards"), and agrees to comply with requirements of that section. The Subcontractor further agrees to complete the Pledge of Compliance, incorporated herein by reference."

ADD:

7-13.8

Equal Pay Ordinance.

1. You shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) in section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.
2. You shall require all of your Subcontractors to certify compliance with the EPO in their written subcontracts.
3. You shall post a notice informing your employees of their rights under the EPO in the workplace or job site.
4. By signing this Contract with the City of San Diego, you acknowledge the EPO requirements and pledge ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

ADD:

7-16.1.3 Weekly Updates Recipients.

1. Submit a weekly correspondence with updates, traffic control issues and locations, lane closures, and any other pertinent information (with additional contact names given during award process) to the following recipients:

Debbie Van Martin, Senior Engineer, Dvanmartin@sandiego.gov

Art Arvizu, Project Engineer, Aarvizu@sandiego.gov

Resident Engineer, TBA, XXX@sandiego.gov

7-16.3 Exclusive Community Liaison Services. To the "WHITEBOOK", ADD the following:

2. You shall retain an Exclusive Community Liaison for the Project that shall implement Work in accordance with the specifications described in 7-16.2 "Community Outreach Services" and 7-16.3 "Exclusive Community Liaison Services".

7-20 ELECTRONIC COMMUNICATION. To the "WHITEBOOK", ADD the following:

2. Virtual Project Manager shall be used on this Contract.

7-21.1 General. To the "WHITEBOOK", item 3, DELETE in its entirety and SUBSTITUTE with the following:

3. During the construction phase of projects, the minimum waste management reduction goal is 90% of the inert material (a material not subject to decomposition such as concrete, asphalt, brick, rock, block, dirt, metal, glass, and etc.) and 65% of the remaining project waste. You shall provide appropriate documentation, including a Waste Management Form attached as an appendix, and evidence of recycling and reuse of materials to meet the waste reduction goals specified.

SECTION 8 - FACILITIES FOR AGENCY PERSONNEL

8-2 FIELD OFFICE FACILITIES. To the "WHITEBOOK", ADD the following:

2. Provide a Class "D" Field Office.

SECTION 9 - MEASUREMENT AND PAYMENT

ADD:

9-3.1.1

Additional Work Items. The following items listed below represent the additional work items for the Pump Station, Reservoir and related appurtenances not included in bid items elsewhere:

	<p>Modify Existing Northwest Altitude Valve Vault: The contract lump sum bid price for Modify Existing Northwest Altitude Valve Vault includes all labor, materials, equipment and incidentals for filling the vault with crushed rock, installation of a concrete slab and drain, new ladder, new compressor and associated piping all in accordance with the Plans, Specifications and Technicals, and Contract Documents. Demolition of the appurtenances in the vault are included in separate bid items.</p>
	<p>Surge Tank and Compressor. The contract lump sum price for Surge Tank and Compressor includes all labor, materials, equipment and incidentals for doing all the work involved in construction of surge tank and associated appurtenances and shall include, but not limited to installation and testing of ASME-rated pressure vessel tanks for surge control including air compressor piping, water level controls, pressure vessel, level gauges, pressure gauge, level probes, and accessory gauges and piping, concrete foundation and support, drain pipe and coating and includes the 8" steel pipe, fittings and appurtenances (excluding 8" gate valves) between the surge tank and connection at the 16" steel pipe as shown on the Plans and in accordance with the Specifications and Technicals, and Contract Documents.</p>
	<p>Miscellaneous Reservoir Upgrades. The Contract Lump Sum Price for Miscellaneous Reservoir Upgrades includes furnishing all labor, materials, equipment and incidentals for the chlorine analyzer and sampling station with associated piping and tubing, new inlet piping and Tideflex mixing system, new external reservoir level gauge, new outlet piping as shown on the Plans and in accordance with the Specifications and Technicals, and Contract Documents.</p>
	<p>Meter and Valve Building. The Contract Lump-sum Bid Price for Meter and Valve Building includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work involved in installation of the new pipe penetrations, piping, couplings, spools, pipe supports, restraint</p>

	<p>harnesses, altitude valve, check valve, fittings and other appurtenances within the existing building and including the concrete walkway leading to the pump station building all in accordance with the Plans, Specifications and Technicals, and Contract Documents.</p> <p>Lead and Asbestos abatement Work within the building shall be included in this Bid item. Refer to the Lead and Asbestos Abatement Report. Handling and Disposal of Non-friable Asbestos Material within the pipelines shall be paid under a separate Bid item.</p> <p>Demolition work, electrical work, butterfly valves and the flow meter are included in separate bid items.</p>
	<p>Pump Station Building. The Contract Lump Sum Price for Pump Station Building includes furnishing all labor, materials, equipment and incidentals for construction of the concrete/masonry building including all structural steel, roofing, windows, doors and other architectural features, external stairs, railings, hatches, stoop, HVAC system, lighting, finishes, metal grating, equipment pads, drain piping, subdrain piping, hoist system, pump bases, structure excavation, and other items necessary for a complete pump station building all in accordance with the Plans, Specifications and Technicals, and Contract Documents. Any items within the building footprint not specifically mentioned for inclusion with other bid items shall be included here.</p>
	<p>Pump Station Piping and Appurtenances. The Contract Lump Sum price for piping and appurtenances inside the pump station includes furnishing all labor, materials, tools, equipment and incidentals for all suction and discharge piping within the building footprint and associated pipe supports, gauges, couplings, restraint harnesses, flanged coupling adapters, spools, air release valves, pump control valves, corporation stops, internal plumbing, copper piping and pipe straps, hose bibbs, pressure relief valves, sump pump with associated appurtenances and any other mechanical appurtenances not mentioned with this bid item or elsewhere all in accordance with the Plans, Specifications and Technicals, and Contract Documents. Butterfly valves, gate valves, vertical turbine pumps, chlorine analyzer station, electrical, HVAC and structural work are included in other bid items.</p>

	<p>Vertical Turbine Pumps, 75 HP, Constant Speed. The Contract Unit Price for vertical turbine pumps, 75 HP, constant speed includes furnishing all labor, materials, tools, equipment and incidentals, for installation of these pumps with associated pump seal lines, gauges and switches, pump can, sole plate, testing and all other equipment necessary, concrete encasements, and other items as necessary for fully operational pump as shown on the Plans and in accordance with the Specifications and Technicals, and Contract Documents.</p>
	<p>Vertical Turbine Pumps, 50 HP, VFD. The Contract Unit Price for vertical turbine pumps, 50 HP, constant speed includes furnishing all labor, materials, tools, equipment and incidentals, for installation of these pumps with associated pump seal lines, gauges and switches, pump can, sole plate, testing and all other equipment necessary, concrete encasements, and other items as necessary for a fully operational pump as shown on the Plans and in accordance with the Specifications and Technicals, and Contract Documents.</p>
	<p>Cathodic Protection System/Testing Stations. The Contract Lump Sum Price for Cathodic Protection System/Testing Stations includes furnishing all labor, materials, tools, equipment and all incidentals, and for doing all the work providing complete cathodic protection system/test station system including, but not limited to, test boxes, wiring, anodes and flange isolation kits as shown on the Plans and in accordance with the Specifications and Technicals, and Contract Documents.</p>

9-3.2

Partial and Final Payment. To the "GREENBOOK", paragraph (3), DELETE in its entirety and SUBSTITUTE with the following:

Upon commencement of the Work, an escrow account shall be established in a financial institution chosen by you and approved by the City. Documentation for an escrow payment shall have an escrow agreement signed by you, the City, and the escrow agent. From each progress payment, no less than 5% will be deducted and deposited by the City into the escrow account. Upon completion of the Contract, the City will notify the Escrow agent in writing to release the funds to you. Only the designated representative of the City shall sign the request for the release of Escrow funds.

**ADD:
9-3.7**

Compensation Adjustments for Price Index Fluctuations. To the "WHITEBOOK" ADD the following:

5. This Contract is not subject to the provisions of The "WHITEBOOK" for Compensation Adjustments for Price Index Fluctuations for paving asphalt.

SECTION 209 – PRESSURE PIPE

209 PRESSURE PIPE. To the "WHITEBOOK", ADD the following:

2. PVC products, specifically type C900 and C905, as manufactured or distributed by J-M Manufacturing Company or JM Eagle shall not be used on the Contract for pressurized pipe.

209-1.1.2 Materials. To the "WHITEBOOK", item 10, ADD the following:

- a) The interior of bells shall be lined as specified in Technicals Section 09800.

209-2 STEEL PIPE AND FITTINGS

209-2.2.1 Materials. To the "GREENBOOK", ADD the following:

Steel pipe wall minimum thickness shall be:

Steel Pipe Diameter	Design Pressure	Pipe Wall Thickness
4" thru 16"	175 psi	0.25 inches

Buried steel piping shall have either butt strap joints with handholes or lap welded joints with handholes fabricated on the pipe to allow for field repair of cement mortar linings.

See Specification Section 09800 for steel pipe lining and coating.

209-4 PVC PRESSURE PIPE

209-4.2 Materials. To the "GREENBOOK", ADD the following:

1. Refer to section 15010, Mill Piping, Exposed and Buried, for information regarding small diameter PVC pipe.

SECTION 212 – WATER AND SEWER SYSTEM VALVES AND APPURTENANCES

212-5 Valves. To the “WHITEBOOK”, item 1, ADD the following:

See Section 09800 for additional lining and coating information.

212-5.1 Resilient Wedge Gate Valves. To the “WHITEBOOK”, ADD the following:

Gate valves 3” and larger shall be resilient seated gate valves per AWWA C509. Gate valves shall be of the rising stem, manually operated type, except for buried valves or where space restrictions require a non-rising stem. Handwheel operators shall be provided at locations shown on the plans.

212-5.2 Butterfly Valves. To the “WHITEBOOK”, ADD the following:

9. Handwheel operators shall be provided at locations shown on the plans.

SECTION 217 – BEDDING AND BACKFILL MATERIALS

217-2.2 Stones, Boulders, and Broken Concrete. To the “GREENBOOK”, Table 217-2.2, DELETE in its entirety and SUBSTITUTE with the following:

TABLE 217-2.2

Zone	Zone Limits	Maximum Size (greatest dimension)	Backfill Requirements in Addition to 217-2.1
Street or Surface Zone	From ground surface to 12” (300 mm) below pavement subgrade or ground surface	2.5” (63 mm)	As required by the Plans or Special Provisions.
Backfill of Tunnels beneath Concrete Flatwork		Sand	Sand equivalent of not less than 30.
Trench Zone	From 12” (300 mm) below pavement subgrade or ground surface to 12” (300 mm) above top of pipe or box	6” (150 mm)	
Deep Trench Zone (Trenches 3’ (0.9 m) wide or wider)	From 60” (1.5 m) below finished surface to 12” (300 mm) above top of pipe or box	Rocks up to 12” (300 mm) excavated from trench may be placed as backfill	
Pipe Zone	From 12” (300 mm) above top of pipe or box to 6” (150 mm) below bottom of pipe or box exterior	2.5” (63 mm)	Sand equivalent of not less than 30 or a coefficient of permeability greater than 1-½ inches/hour (35 mm per hour).

Zone	Zone Limits	Maximum Size (greatest dimension)	Backfill Requirements in Addition to 217-2.1
Overexcavation	Backfill more than 6" (150 mm) below bottom of pipe or box exterior	6" (150 mm)	Sand equivalent of not less than 30 or a coefficient of permeability greater than 1-½ inches/hour (35 mm per hour). Trench backfill slurry (100-E-100) per 201-1 may also be used.

SECTION 302 – ROADWAY SURFACING

302-5.9 Measurement and Payment. To the "WHITEBOOK", item 2, DELETE in its entirety and SUBSTITUTE with the following:

2. Payment for the asphalt curb shall be included in the bid item "**Asphalt Concrete Dike Type A**" and also includes demolition and removal of the existing curb along with construction of new asphalt curb.

302-7.4 Payment. To the "WHITEBOOK", item 1, last sentence, DELETE in its entirety and SUBSTITUTE with the following:

Payment shall not be made for additional fabric for overlapped areas.

SECTION 303 – CONCRETE AND MASONRY CONSTRUCTION

303-5.9 Measurement and Payment. To the "WHITEBOOK", ADD the following:

7. Payment for the concrete ribbon gutter shall be included in the bid item "Concrete Ribbon Gutter" and also includes the concrete apron near the storm drain facilities.

SECTION 306 – OPEN TRENCH CONDUIT CONSTRUCTION

306-3.3.1 Removal and Abandonment of Existing Water Facilities. To the WHITEBOOK, ADD the following:

8. The western altitude valve vault will be converted to a vault housing the air compressor. All piping, fittings, conduit, wiring shall be removed so the vault is empty. The adjacent air release valve and enclosure will be removed and disposed with associated piping abandoned in place. The ends of the 16" water pipeline entering and exiting the vault shall be plugged per City of San Diego drawing WP-03.

10. The eastern altitude valve vault will be abandoned in place. All piping, fittings, conduit, wiring and other appurtenances shall be removed so the vault is empty. The ends of the water piping entering and exiting the vault shall be plugged per City of San Diego drawing WP-03. The upper portion of the vault will be removed and the bottom will be broken up to allow water to escape. The remaining vault will be backfilled with sand.

306-3.3.3 Payment. To the "WHITEBOOK", item 2, DELETE in its entirety and SUBSTITUTE with the following:

2. The payment for removing, plugging and abandoning existing water facilities and appurtenances will include all remaining miscellaneous water facilities such as piping, air valves and enclosures, manholes, meters, valves, valve cans not included in other bid items at the lump sum price under the bid item "**Removal or Abandonment of Existing Water Facilities**".

To the "WHITEBOOK", ADD the following:

9. The payment for electrical demolition and abandonment shall be included in the lump sum bid item for "**Electrical Demolition and Abandonment**" and includes all material, labor, equipment, permitting required for removal, relocation and abandonment of all electrical, lighting and communication facilities as shown on the plans.
10. The payment for demolition and abandonment of the western altitude valve vault shall be included in the lump sum bid item for "**Western Altitude Valve Vault Demolition and Abandonment**" and shall include the demolition and partial abandonment of the vault and adjacent air valve as shown on the plans.
11. The payment for demolition and abandonment of irrigation facilities shall be included in the lump sum bid item for "**Irrigation Demolition and Abandonment**" and shall include the demolition, relocation and abandonment of all irrigation piping, fittings, valves, miscellaneous appurtenances, valve boxes, enclosures as shown on the plans.
12. The payment for demolition and abandonment of the eastern altitude valve vault shall be included in the lump sum bid item for "**Eastern Altitude Valve Vault Demolition and Abandonment**" and shall include the demolition and abandonment of the vault and adjacent piping as shown on the plans.

306-6.5.1 General. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. For PVC water pipes:
 - a) Bedding material shall:
 - i. Either be sand, crushed aggregate, or native free-draining granular material.
 - ii. 100% of the bedding material shall pass the no. 4 sieve and shall have an expansion when saturated with water of not more than 0.5%.
 - iii. Have a sand equivalent of SE 50. SE 30 or higher may be substituted for SE 50 as bedding material if all of the following requirements are met:
 - The top of the pipe and haunch areas are mechanically compacted by means of tamping, vibrating roller, or other mechanical tamper.
 - Equipment is of size and type approved by the Engineer.
 - 90% relative compaction or better is achieved.
 - b) When jetting, care shall be exercised to avoid floating of the pipe.
2. PVC sewer pipes shall be bedded in 3/8 inch (9.5 mm) or 1/2 inch (12.5 mm) crushed rock in accordance with 200-1.2, "Crushed Rock and Rock Dust". Crushed rock for PVC sewer pipes may contain recycled Portland Cement Concrete and shall conform to gradation requirements for 3/8 inch or 1/2 inch nominal size as shown in Table 200-1.2.1 (A).
3. Storm drains and all types of non-PVC sewer mains shall be bedded in 3/4 inch (19 mm) crushed rock in accordance with 200-1.2, "Crushed Rock and Rock Dust". Crushed rock for storm drains may contain recycled Portland Cement Concrete and shall conform to gradation requirements for 3/4 inch nominal size as shown in Table 200-1.2.1 (A). Bedding shall be placed to a depth of 4 inches (101.6 mm) below the outside diameter of the pipe or 1 inch (25.4 mm) below the bell of the pipe, whichever is greater.

306-7.8.2.1 General. To the "WHITEBOOK", item 2, ADD the following:

- a) Specified design pressure for Class 235 pipe shall be 150 psi and is tested at 225 psi.
- b) Specified design pressure for Class 305 pipe shall be 200 psi and is tested at 300 psi.

306-8 PREFABRICATED PRESSURE PIPE.

306-8.3.3 Acceptance. To the GREENBOOK, ADD the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Steel Pipe Fillet Welds and Lap Welds	Field Inspection of Exterior Welds	Visual Inspection of Pipe Exterior Welds per AWWA C206 Section 5.1 Verify absence of sharp edges, weld spatters, and burrs	All exterior steel pipe single-welded or double-welded joints	Owner	Owner
	Field Inspection of Interior Welds on Double-Welded Joints	Visual Inspection of Pipe Interior Welds per AWWA C605 Section 5.1. Verify absence of sharp edges, weld spatters, and burrs	All interior steel pipe double- welded joints	Owner	Owner
	Field Welding (Lap Weld) of Joints on Pipe Exterior (Air Soap Test)	AWWA C206 Section 5.2	All double-welded lap joints	Contractor	Contractor
Installed Steel Pipe	Cement-Mortar Lining of Joints	AWWA C602 Section 5.3 Video inspection of interior of finished installation	1 inspection of all steel pipe joints	Contractor	Contractor
	Installation & Leakage	Visual inspection of exterior of finished installation. No visible leaks	1 inspection	Owner	Owner
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

306-15.1 Payment: To the WHITEBOOK, ADD the following:

- n) The bid item **“Water main 16 inch”** does not include the piping inside the meter vault or pump station building. The piping inside these building is included in their respective bid items.

306-15.2 Shoring and Bracing. To the “WHITEBOOK”, DELETE in its entirety and SUBSTITUTE with the following:

- 1. The Bid item for “Trench Shoring” shall include full compensation for furnishing, installing, maintaining, and removing all sheeting, shoring, or bracing for any conditions encountered that require shoring including the preparation of

engineered Shoring Plans in accordance with 7-10.4.2.2, "Shoring Plan". No additional payment shall be made.

306-15.8 Pipeline and Appurtenances. To the "WHITEBOOK", item 8, DELETE in its entirety and SUBSTITUTE the following:

8. Payment for air release valves within the pump station will be included in a separate bid item. Payment for the two offsite air valve locations will be included in the contract unit price bid item "**Combination Vacuum Relief-Air Inlet and Air Release Valves, (2", Class 150)**" and will include all materials, equipment and labor necessary to install these air valves in their respective locations including all traffic control, earthwork, pavement repairs, tapping saddles, piping, valves, enclosures, concrete work, testing, disinfection and any other work necessary for a complete, operable combination vacuum relief – air inlet and air release valve assembly.

To the "WHITEBOOK", ADD the following:

9. Payment for the for the "**6" emergency bypass connections**" shall be included in the lump sum bid item and shall include all equipment, labor and materials necessary (excluding the gate valves which are included in a separate bid item) to provide a fully functional bypass assembly.
10. Payment for each double ball expansion joint will be made at the contract unit price for the bid item "**Double-Ball Expansion joint**"

SECTION 314 – TRAFFIC STRIPING, CURB AND PAVEMENT MARKINGS, AND PAVEMENT MARKERS

314-2.3 Payment. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. Payment for removal of traffic striping, pavement markings, and curb markings will be made at a Lump Sum contract price for "**Removal of Traffic Striping and Curb Markings**".

314-4.3.7 Payment. To the "GREENBOOK", ADD the following:

2. The payment for the replacement of existing traffic striping, pavement markings, and pavement markers shall be included in the Bid item for "**Striping**" and shall also include the payment for new installations of traffic striping, pavement markings, and pavement markers.

314-4.4.6 Payment. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The payment for the replacement of existing traffic striping, pavement markings, and pavement markers shall be included in the Bid item for

“Striping” and shall also include the payment for new installations of traffic striping, pavement markings, and pavement markers.

SECTION 600 - ACCESS

ADD:

600-1

GENERAL. To the “WHITEBOOK”, item 5, DELETE in its entirety and SUBSTITUTE with the following:

5. If the City’s crews are unable to provide the citizens with the mandated services due to your failure to comply with these specifications, you shall collect trash, recyclables, and yard waste on the City’s schedule and deliver to the City’s designated locations. If you fail to perform this Work, you shall incur additional costs for the City to reschedule pick up of an area.

601-6

PAYMENT: To the “WHITEBOOK”, DELETE item 3 and SUBSTITUTE with the following:

3. The bid item for “**Traffic Control**” shall include the payment for all traffic control devices, required signs, notices, detours, usage of provided traffic control plans, preparation of traffic control plans at the 2 offsite air valve sites and any permitting necessary.

SECTION 701 – CONSTRUCTION

701-2

PAYMENT. To the “WHITEBOOK”, ADD the following:

19. All electrical work including conduit, cable, panels, switches, controls, instrumentation, SCADA programming, lightings, sight security, communications and other related work will be included in the lump sum bid item for “**Electrical and Instrumentation**” in accordance with the Plans, Technicals, and Contract Documents.

SECTION 800 - MATERIALS

800-1.2.3

Commercial Fertilizer. To the “GREENBOOK”, ADD the following:

1. Provide Pre-Plant Fertilizer with not more than 6% total nitrogen, not less than 20% available phosphoric acid, and 20% soluble potash.
2. Provide Pre-Plant Fertilizer with percentage of nitrogen required to provide not less than a total of 16 pounds of actual nitrogen, 6% phosphoric acid and 8% potassium.
3. Provide Fertilizer Tablets with 21 grams.

800-1.2.4

Organic Soil Amendment. To the “GREENBOOK”, ADD the following:

Organic Soil Amendment shall be “Type 1”.

800-1.2.5 Mulch. To the "WHITEBOOK", item 3, subsection "i", ADD the following:
Mulch shall be "Type 5" (Fir Bark Chips).

SECTION 801 - INSTALLATION

801-4.6 Plant Staking and Guying. To the "WHITEBOOK", ADD the following:

Tree Staking shall be 'Method A' Tree Staking in the GREENBOOK.

801-4.7 Ground Cover and Vine Planting. To the "WHITEBOOK", ADD the following:

7. Apply 3" layer of Type 5 Mulch to all planted areas, after final soil surface has been raked smooth with no depressions and all weeds have been removed.

801-5.5.2 Location, Elevation, and Spacing. To the "WHITEBOOK", ADD the following:

Spray heads to be located min. 24" away from any paved surface to eliminate overspray, water waste, and run-off.

801-5.7.2.2 Pressure Test. To the "WHITEBOOK", ADD the following:

Use 'Method A' Pressure Test in the GREENBOOK.

801-6 MAINTENANCE AND PLANT ESTABLISHMENT. To the "WHITEBOOK", ADD the following:

10. Plant Establishment Period shall be for a period of 120 Calendar Days.
11. Provide 1 year guarantee period for all trees planted as part of this project.
12. Provide 120 day guarantee period for all shrubs, groundcovers, and vines planted as part of this project.
13. Replace unhealthy, damaged or dead plants within 14 days.

801-9 PAYMENT. To the "WHITEBOOK", REMOVE and SUBSTITUTE with the following:

1. The payment for all landscaping and irrigation work shall be included under the lump sum bid item "Landscaping and Irrigation" in accordance with the Plans, Technicals, and Contract Documents.

SECTION 900 - MATERIALS

900-1.1.1 Galvanized Pipe. To the "WHITEBOOK", Item 8 Hoses, DELETE in its entirety and SUBSTITUTE with the following:

8. Hoses:
 - a) User Connection (Service Meters).

- i. For meters up to 1 inch (25.4 mm), the hose shall be 1 inch (25.4 mm) potable water hose with 300 WP rating. End connections shall be galvanized steel, "Chicago" 2-lug, quarter-turn, quick-disconnect fittings banded to the hose.
 - ii. Materials shall meet the NSF/ANSI 61 certification for potable water use in conformance with AWWA C651-14.
- b) Curves and Curbs.
- i. Hose shall be 2 inch (50.8 mm) potable water hose with 300 WP rating. End connections shall be galvanized steel grooved mechanical end fittings in compliance with ASTM C606 banded to the hose.
 - ii. Materials shall meet the NSF/ANSI 61 certification for potable water use in conformance with AWWA C651-14.

900-1.1.3 Yelomine Pipe. To the "WHITEBOOK", Item 8 Hoses, DELETE in its entirety and SUBSTITUTE with the following:

8. Hoses:

- a) User Connection (Service Meters).
- i. For meters up to 1 inch (25.4 mm), the hose shall be 1 inch (25.4 mm) potable water hose with 300 WP rating. End connections shall be galvanized steel, "Chicago" 2-lug, quarter-turn, quick-disconnect fittings banded to the hose.
 - ii. Materials shall meet the NSF/ANSI 61 certification for potable water use in conformance with AWWA C651-14.
- b) Curves and Curbs.
- i. Hose shall be 2 inch (50.8 mm) potable water hose with 300 WP rating. End connections shall be galvanized steel grooved mechanical end fittings in compliance with ASTM C606 banded to the hose.
 - ii. Materials shall meet the NSF/ANSI 61 certification for potable water use in conformance with AWWA C651-14.

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP) SECTION A – GENERAL REQUIREMENTS

- 4.1 Nondiscrimination in Contracting Ordinance.** To the “WHITEBOOK”, subsection 4.1.1, paragraph (2), sentence (1), DELETE in its entirety and SUBSTITUTE with the following:

You shall not discriminate on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers.

END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

TECHNICALS

Soledad Pump Station Upgrades

Final Submittal Technical Specification

Per 2015 Greenbook and City of San Diego 2015 Whitebook

January, 2018

Psomas
401 B Street
Suite 1600
San Diego, CA 92101

TECHNICALS

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15000 Piping Components
15010 Mill Piping- Exposed and Buried
15020 Pipe Supports
15030 Pipe Identification Systems
15050 Vibration Isolation
15065 Stainless Steel Pipe
15100 Valves, General
15101 Valve and Gate Operators
15113 Air Release and Vacuum Valves
15116 Stainless Steel Valves 3-inches and Smaller
15117 Pump Control Valves and Pressure Relief Valves

- 15118 Expansion Joints
- 15120 Altitude Valves
- 15156 Magnetic Flow Meters
- 15175 Hydropneumatic Surge Control Systems

DIVISION 16 – ELECTRICAL

(Also See Division 26)

- 16040 Electric Motors
- 16640 Cathodic Protection System

DIVISION 23– HVAC MECHANICAL

(Also See Division 15)

- 230000 General Mechanical Requirements
- 230500 Basic Mechanical Materials and Methods
- 230529 Hangers and Supports for HVAC Piping and Equipment
- 230548 Vibration and Seismic Controls for HVAC Piping and Equipment
- 230553 Identification for HVAC Piping and Equipment
- 232300 Refrigeration Piping
- 233113 Metal Ducts
- 233300 Air Duct Accessories
- 233423 HVAC Power Ventilators
- 233713 Diffusers, Registers, and Grilles
- 238126 Split-System-Air-Conditioners

DIVISION 26 – ELECTRICAL

(Also See Division 16)

- 260519 Low-Voltage Electrical Power Conductors and Cables
- 260526 Grounding and Bonding for Electrical Systems
- 260529 Hangers And Supports For Electrical Systems
- 260530 Process Instrumentation and Control System (PICS) – General
- 260531 Instrumentation and Control
- 260533 Raceways and Boxes For Electrical Systems
- 260543 Underground Ducts And Raceways For Electrical Systems
- 260553 Identification For Electrical Systems
- 260563 Uninterruptible Power Supply
- 262413 Switchboards
- 262416 Panelboards
- 262419 Motor-control Centers
- 262726 Wiring Devices
- 262816 Enclosed Switches And Circuit Breakers
- 263600 Transfer Switches
- 265119 LED Interior Lighting
- 265613 Lighting Poles and Standards
- 265619 LED Exterior Lighting

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

- 282300 Video Surveillance

SECTION 01300

CONTRACTOR SUBMITTALS

PART 1 – GENERAL

1.1 GENERAL

- A. Wherever submittals are required hereunder, all such submittals by the CONTRACTOR shall be submitted to the CONSTRUCTION MANAGER.
- B. Within seven (7) calendar days after the date of commencement as stated in the Notice to Proceed (NTP), the CONTRACTOR shall submit the following items to the CONSTRUCTION MANAGER for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and submittals listed in the Bid.
 - 2. A list of all permits and licenses the CONTRACTOR shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.
- C. At the preconstruction conference, the CONTRACTOR shall submit the following items to the CONSTRUCTION MANAGER for review:
 - 1. A 60-day plan of operation in accordance with Greenbook/Whitebook.
 - 2. A project overview bar chart in accordance with Greenbook/Whitebook.
 - 3. A preliminary schedule of values in accordance with Greenbook/Whitebook.

1.2 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents, or where required by the CONSTRUCTION MANAGER, the CONTRACTOR shall furnish to the CONSTRUCTION MANAGER for review, 6 copies, plus the number the CONTRACTOR wants returned, not to exceed 12 copies, plus one reproducible copy, of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items.
- B. All shop drawing submittals shall be accompanied by the CONSTRUCTION MANAGER's standard submittal transmittal form. The form may be obtained from the CONSTRUCTION MANAGER. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.
- C. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page

submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the CONSTRUCTION MANAGER.

- D. Except as may otherwise be indicated herein, the CONSTRUCTION MANAGER will return prints of each submittal to the CONTRACTOR with its comments noted thereon, within 15 calendar days following their receipt by the CONSTRUCTION MANAGER. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the CONSTRUCTION MANAGER by the second submission of a submittal item. The OWNER reserves the right to withhold monies due the CONTRACTOR to cover additional costs of the CONSTRUCTION MANAGER's review beyond the second submittal. The CONSTRUCTION MANAGER'S maximum review period for each submittal, including all resubmittals, will be 15 days per submittal. In other words, for a submittal that requires two resubmittals before it is complete, the maximum review period for that submittal could be 45 days.
- E. If three (3) copies of a submittal are returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.
- F. If three (3) copies of a submittal are returned to the CONTRACTOR marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.
- G. If a submittal is returned to the CONTRACTOR marked "AMEND-RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the CONSTRUCTION MANAGER.
- H. If a submittal is returned to the CONTRACTOR marked "REJECTED-RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the CONSTRUCTION MANAGER.
- I. Fabrication of an item shall be commenced only after the CONSTRUCTION MANAGER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.
- J. All CONTRACTOR shop drawing submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR, prior to submission to the CONSTRUCTION MANAGER. Each submittal shall be dated, signed, and certified by the CONTRACTOR, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the CONSTRUCTION MANAGER of any CONTRACTOR submittals will be made for any items which have not been so certified by the CONTRACTOR. All non-certified submittals will be returned to the CONTRACTOR without action taken by the CONSTRUCTION MANAGER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- K. The CONSTRUCTION MANAGER's/ENGINEER's review of CONTRACTOR shop drawing submittals is for general conformance with the design concept and contract documents only and shall not relieve the CONTRACTOR of the entire responsibility for the correctness of details and dimensions. The CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR submittals. The CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details. Markings or comments shall not be construed as relieving the CONTRACTOR from compliance with the project plans and specifications

or departures therefrom. The CONTRACTOR remains responsible for details and accuracy for confirming and correlating all quantities and dimensions, for selecting fabrication processes, the techniques of assembly, and for performing his work in a safe manner.

1.3 CONTRACTOR'S SCHEDULE

- A. The CONTRACTOR's construction schedules and reports shall be prepared and submitted to the CONSTRUCTION MANAGER.

1.4 SAMPLES

- A. Whenever in the Specifications samples are required, the CONTRACTOR shall submit not less than three (3) samples of each such item or material to the CONSTRUCTION MANAGER for acceptance at no additional cost to the OWNER.
- B. Samples, as required herein, shall be submitted for acceptance a minimum of 21 days prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the WORK.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name for identification and submitted to the CONSTRUCTION MANAGER for acceptance. Upon receiving acceptance of the CONSTRUCTION MANAGER, one set of the samples will be stamped and dated by the CONSTRUCTION MANAGER and returned to the CONTRACTOR, and one set of samples will be retained by the CONSTRUCTION MANAGER, and one set of samples shall remain at the job site until completion of the WORK.
- D. Unless indicated otherwise, all colors and textures of specified items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in contract time or price, the CONTRACTOR will clearly indicate same on the transmittal page of the submittal.

1.5 OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS)

- A. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS). The OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS) shall be written so that it can be used and understood by the OWNER'S operation and maintenance staff. Each individual force main and the generator shall have its own independent and unique OWNER's MANUAL (OR OPERATION AND MAINTENANCE MANUALS).
- B. Each OWNER'S MANUAL (OR OPERATION AND MAINTENANCE MANUALS) shall be subdivided first by specification section number; second, by equipment item; and last, by "part." "Parts" shall conform to the following (as applicable):
 - 1. Part 1 - Equipment Summary
 - a. Summary: A summary table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.

- b. Form: The CONSTRUCTION MANAGER will supply an Equipment Summary Form for each item of mechanical, electrical and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.
2. Part 2 - Operational Procedures
- a. Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:
 - Installation
 - Adjustment
 - Startup
 - Location of controls, special tools or other equipment required or related instrumentation needed for operation
 - Operation Procedures
 - Load Changes
 - Calibration
 - Shutdown
 - Troubleshooting
 - Disassembly
 - Reassembly
 - Realignment
 - Testing to determine performance efficiency
 - Tabulation of proper settings for all pressure relief valves, low and high pressure switches and other protection devices
 - List of all electrical relay settings including alarm and contact settings
3. Part 3 - Preventive Maintenance Procedures
- a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component and by leaving the equipment in place.
 - b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade and type, and temperature ranges shall be covered.
4. Part 4 - Parts List
- a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
 - b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list.
5. Part 5 - Wiring Diagrams
- a. Diagrams: Part 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

6. Part 6 - Shop Drawings
 - a. Drawings: This part shall include approved shop or fabrication drawings, complete with dimensions.
 7. Part 7 - Safety
 - a. Procedures: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.
 8. Part 8 - Documentation
 - a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.
- C. The CONTRACTOR shall furnish to the CONSTRUCTION MANAGER seven (7) identical OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS). Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, looseleaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents indicating all equipment in the manuals shall be prepared.
- D. OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS) shall be submitted in final form to the CONSTRUCTION MANAGER not later than the 75 percent of construction completion date. All discrepancies found by the CONSTRUCTION MANAGER in the OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS) shall be corrected by the CONTRACTOR within 15 calendar days from the date of written notification by the CONSTRUCTION MANAGER.
- E. Incomplete or unacceptable OWNER'S MANUALS (OR OPERATION AND MAINTENANCE MANUALS) at the 75 percent construction completion point shall constitute sufficient justification to withhold the amount stipulated in paragraph "OWNER'S MANUAL (OR OPERATION AND MAINTENANCE MANUALS) Submittals" of Section 01700, from any monies due the CONTRACTOR.

1.6 INSTRUCTION OF OWNER'S PERSONNEL

A. **General:**

1. Training is not generally a part of the contract, unless it is specifically called out in the technical specifications. If the OWNER determines that certain training is desired on a particular component or a portion of the contract not required of the technical specifications, a field order or change order will be executed in order to facilitate such training for the wastewater collections staff.

1.7 ELECTRONIC DOCUMENT SUBMITTAL REQUIREMENTS

A. **General**

1. All final submittals are required in both paper and electronic format. Four (4) copies of each final submittal shall be provided on compact disk media (CD-ROM).
2. Where preliminary submittals are required in electronic format, three (3) copies of the preliminary submittal shall be provided on CD-ROM for review.

3. CD-ROM disks shall be on high-quality CD-R media. CDs shall have printed paper labels with the project name, CIP Number, CONTRACTOR, and content. CD-RW (CD-rewritable) disks are not acceptable. CDs shall be provided with a case and a case insert label displaying the same information shown on the CD label.
 4. The CD-ROM data format shall comply with ISO 9660 (2010) with Joliet extensions.
 5. Deviation from this standard will be accepted only if advance approval is given by the CONSTRUCTION MANAGER.
- A. **Documents:** Electronic submittals for the following types of documents are required as a minimum. Additional requirements are identified in the equipment specifications.
1. Design
 - (a) Design Specifications
 - (b) Design Drawings and record drawings
 2. Operations and Maintenance
 - (a) Facility design O&M manuals
 1. Volume I - process information
 2. Volume II - standard operating procedures (SOP)
 3. Volume III - all maintenance information for the facility.
 4. Manufacturer O&M manuals
 5. Facility Loop and Wiring Diagrams
 3. Environmental Documents
 4. Research & Development
- B. **Format**
1. Construction drawings and record drawings developed under the Contract shall be in Bentley Microstation (DGN V8 version) format. All drawings shall conform to the CADD and Drafting standards set forth in the CWP Guidelines, latest edition.
 2. Other than construction drawings and record drawings, documents shall be in Adobe Acrobat PDF format, using the Acrobat version as specified by the CONSTRUCTION MANAGER. Documents that are submitted in Acrobat Image Only format will not be accepted.
 3. Electronic Conversion: Vendor and CONTRACTOR shop drawings developed under the Contract shall be in Bentley Microstation (DGN) format. Documents in electronic format (Microsoft Word, Excel, etc.) shall be converted to standard PDF format using the Acrobat printer driver or other direct conversion software. The Acrobat PDF sub-format for electronically converted documents shall be the Acrobat Standard PDF file format which includes both image and text information.
 4. Documents not available in electronic format shall be scanned at 300 dpi, bitonal (black and white) and converted into Adobe Acrobat (PDF). Image enhancement software shall be used during scanning. The Acrobat PDF sub-format for scanned documents shall be the Original Image with Hidden Text format.

5. All PDF documents shall be reviewed, and corrected if necessary, for orientation and legibility.
6. Individual document files shall not exceed 3 megabytes in size. Large documents shall be broken down by subsections to facilitate this requirement

C. Document Organization and Indexing

1. Electronic submittals shall be logically organized. File names shall be in UPPERCASE only, use a maximum of 64 characters, contain no spaces, and clearly indicate the file contents.
2. Supplier's submittals that include O&M documentation for more than one equipment type shall be divided into separate documents for each equipment type.
3. Each document's Table of Contents shall contain PDF bookmarks which actively link to the referenced sections within the document.
4. A master PDF index file shall be included, with a master Table of Contents, and active internal links to individual document files. The master PDF index file shall be clearly identifiable. External PDF link file names shall be in uppercase only.
5. A table shall be provided and submitted in spreadsheet format which includes the information about each document file. The contents of the table shall be submitted and approved by the CONSTRUCTION MANAGER. An example of information to be provided is as follows: (This is an example only.)

(a) Document file name

- (1) Document title and description
- (2) Hard Copy Catalog No. (used by facility document coordinator)
- (3) Document Type: (see above)
- (4) Facility Name
- (5) Specification Number
- (6) Process Name
- (7) Unit Process Number
- (8) Manufacturer's Name (if applicable)
- (9) Supplier's Name (if applicable)
- (10) EMPAC asset number (if applicable)
- (11) Asset Description (if applicable)
 - (a) Keyword
 - (b) Qualifier

1.8 SPARE PARTS LIST

- A. The CONTRACTOR shall furnish to the CONSTRUCTION MANAGER five (5) identical sets of spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the OWNER in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the OWNER in ordering. The CONTRACTOR shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3-ring, looseleaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.9 RECORD DRAWINGS (one component of the Project Master Record Documents as identified in specification)

- A. The CONTRACTOR shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the WORK as actually constructed. These master record drawings of the CONTRACTOR's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the WORK.

Copies of the record drawings shall be submitted on the 20th working day of every month after the month in which the notice to proceed is given as well as on completion of WORK. Failure to submit complete record drawings on or before the 20th working day will enact the liquidated damages clause for interim record drawings submittals described in Article 3 of the Agreement.

- B. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- C. Record drawings shall be accessible to the CONSTRUCTION MANAGER at all times during the construction period.
- D. Final payment will not be acted upon until the CONTRACTOR-prepared record drawings have been delivered to the CONSTRUCTION MANAGER. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid in red.
- D. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of record drawings to the CONSTRUCTION MANAGER for transmittal to the OWNER, conforming to the construction records of the CONTRACTOR. This set of drawings shall consist of corrected drawings showing the reported location of the WORK. The information submitted by the CONTRACTOR in the Record Drawings will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

****END OF SECTION****

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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 pump station, utilizing potable water.
2. The CONTRACTOR shall be required to start up the facility, under direction of the OWNER, 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 OWNER'S REPRESENTATIVE. 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 OWNER 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 OWNER'S REPRESENTATIVE, 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 OWNER'S REPRESENTATIVE for start-up of equipment and systems.
- 3 Review procedures for facility start-up.
- 4 Review outstanding punch list items with the OWNER'S REPRESENTATIVE 15 days prior to the scheduled start-up; and complete, correct, or resolve at the option of the OWNER'S REPRESENTATIVE, 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 OWNER'S REPRESENTATIVE a list of 24 hour, "on call" representative supervisory persons who will monitor the facility start-up, and serve as a liaison for the OWNER'S REPRESENTATIVE and the OWNER.
 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 OWNER'S REPRESENTATIVE. Repairs deemed the responsibility of the CONTRACTOR shall be made at no additional cost to the OWNER.
 12. Provide training of OWNER'S personnel as specified.
- B. The OWNER'S REPRESENTATIVE'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 OWNER'S PERSONNEL

A. General

1. 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 OWNER's personnel for:

- 1 All equipment and systems
- 2 All pumps, valves, meters, hydropneumatic surge tank, sampling system, and related accessories
- 3 All instruments and control devices
- 4 All electrical gear

B. 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)*

Form
No.

Lubrication Summary						
Description		Tag No.		Page _____ of _____		
Lubrication Point						
T Y P E	1	Manufacturer	Product	AGMAS	SAE	ISO
	2					
	3					
	4					
	5					
	Lubrication Point					
T Y P E	1	Manufacturer	Product	AGMAS	SAE	ISO
	2					
	3					
	4					
	5					
	Lubrication Point					
T Y P E	1	Manufacturer	Product	AGMAS	SAE	ISO
	2					
	3					
	4					
	5					
	Safety Hazards					
Special instructions or warnings associated with this equipment:						

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(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: Electronic PDF except where binders are required, whereas, 5 copies would be submitted.
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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

****END OF SECTION****

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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 manufacturer's recommendations. Protect from weather, condensation and humidity.
- D. Parts and materials shall be delivered to the OWNER upon Substantial Completion of the Work or before start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the OWNER. The turnover procedures shall be developed by the CONSTRUCTION MANAGER.
- E. Provide a letter of transmittal and spare parts receiver form including the following:
 - 1 Date of letter and transfer of parts and material.
 - 2 Contract title and number.
 - 3 CONTRACTOR's name and address.
 - 4 Transmittal should lists applicable specification sections for each set of spare parts supplied.
 - 5 Spare Parts Receiver Form.
- F. CONTRACTOR shall be fully responsible for loss or damage to parts and materials until they are transmitted to the OWNER.

1.2 RELATED SECTIONS

- A. The work of the following Sections applies to the Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 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 Soledad Reservoir and adjacent Soledad Pump Station in addition to the requirements of the Standard Specifications for Public Works Construction 2015 (WHITEBOOK).
- 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. International Building Code

1.3 ASBESTOS CEMENT PIPE REMOVAL

- A. Remove and dispose existing AC pipes within the limits indicated in the drawings according to "Whitebook" Section 306-3.3.4.

1.4 PAYMENT

- A. The payment for removal of concrete walls shall be included in the lump sum bid item for "Concrete Block Wall Demolition" and will include all labor, materials and equipment necessary to remove and dispose concrete block walls and associated subdrains.
- B. The payment for removal of concrete ditches shall be included in the lump sum bid item for "Concrete Ditch Demolition" and will include all labor, materials and equipment necessary to remove and dispose concrete ditches and associated inlets and drainage pipes.
- C. The payment for removal of fencing shall be included in the unit price bid item for "Fencing Demolition" and will include all labor, materials and equipment necessary to remove and dispose the perimeter fence, gates, key pad, gate operators and associated concrete footings and anchors.
- D. The payment for removal and abandonment of existing storm drain facilities shall be included in the lump sum bid item for "Storm Drain Demolition" and will include all labor, materials and equipment necessary to remove, relocate, abandon and/or dispose of storm drain structures and piping.
- E. The payment for demolition of the existing pump station building shall be included in the lump sum bid item for "Pump Station Building Demolition" and will include all labor, materials and equipment necessary to remove, salvage and/or dispose of all the equipment inside the building including pumps, valves, piping, conduit, electrical control panels, and all other appurtenances. This bid item will also include demolition of the adjacent concrete stairs and handrail and removal/relocation of external ground rods. Some of the equipment will be salvaged and provided to the City as shown on the plans.

- F. Refer to the Whitebook and Special Provisions for other payment clauses associated with demolition.

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 it 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.
- B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement, or collapse of structures to be demolished.
- C. Existing landscaping materials, structures and appurtenances which are not to be demolished shall be protected and maintained as necessary.
- D. Unless otherwise indicated, the CONTRACTOR shall protect and maintain all utilities in the proximity of the facilities to be demolished.

3.3 HAZARDOUS MATERIAL

- A. Items requiring demolition should be surveyed for hazardous materials or materials in hazardous condition. Lead containing paint and asbestos gaskets may be encountered. Contractor shall coordinate with ALMP to provide the testing."

The request form is located on the City intranet page /Environmental Services/ Documents/ Forms/ Asbestos, Lead and Mold Program Resources.

3.4 STRUCTURE DEMOLITION

- A. 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. The existing pump station building will remain in place and be converted to a new meter/valve building. All existing pumps, piping, valves, appurtenances and electrical

equipment inside the building will be removed and either salvaged or disposed offsite. Pump cans shall be filled with cement slurry. The adjacent concrete stairs and handrail will be removed as part of this project and existing ground rods will be removed/relocated as necessary. See the construction plans for more information.

- G. 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 OWNER. If in the opinion of the OWNER's Representative, 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 OWNER's Representative. No blasting will be permitted.

3.5 BELOW-GRADE DEMOLITION

- A. Unless noted otherwise, footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed entirely including foundations.
- B. Unless noted otherwise, below-grade areas and voids resulting from demolition of structures shall be completely filled with granular sand and compacted to a minimum compaction of 95%.
- C. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around 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.

3.7 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 damage caused to adjacent facilities by demolition at no additional cost to the OWNER.
- C. After patching and repairing has been completed, the CONTRACTOR shall carefully remove splattering of mortar from adjoining work (plumbing fixtures, trim, tile, and finished metal surfaces) and repair any damage caused by such cleaning operations.

3.8 REMOVAL AND ABANDONMENT OF EXISTING WATER FACILITIES

- A. The CONTRACTOR shall remove or abandon existing water facilities where required to perform WORK. Removal and abandonment of existing water facilities shall be in accordance with "WHITEBOOK" Section 306-3.3.1.

3.9 REMOVAL AND ABANDONMENT OF EXISTING FENCING

- A. The CONTRACTOR shall remove the perimeter fencing as shown on the plans. Removal includes all fencing, gates; both vehicular and pedestrian, key pad, gate operators and all associated concrete footings and anchors.

3.10 REMOVAL AND ABANDONMENT OF EXISTING STORM DRAIN

- A. The CONTRACTOR shall remove and abandon the existing storm drain and tank drain facilities as shown on the plans.

3.11 CLEANING

- A. During and upon completion of WORK, the CONTRACTOR shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by 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 02200

EARTHWORK

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes all earthwork required for construction of the project. Such earthwork shall include the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the WORK. The CONTRACTOR shall comply with all local, state and federal safety and health standards, laws and regulations.
- B. Fill material is defined as material used to raise the level of a portion of the site to the line and grade indicated. Backfill material is defined as material used to refill an excavation.

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 02050 Demolition

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Where conflicts arise between this document and the referenced specification, code, or standard, the more restrictive specifications shall govern. The publication is referenced in the text by basic designation only. The latest edition available on the date of issue of Contract Documents shall be used.
 - 1. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC) and the City of San Diego Supplements WHITEBOOK.
 - 2. Reference to soil classification types shall be pursuant to the Unified Soil Classification System.
 - 3. The project Geotechnical Report entitled "Report of Geotechnical Investigation, Soledad Pump Station Replacement, 6751 La Jolla Scenic Drive, La Jolla, California" prepared by Allied Geotechnical Engineers, Inc., dated June 15, 2015.

1.4 REGULATORY REQUIREMENTS

- A. The WORK of this Section shall comply with current versions, with revisions, of the following:
 - 1. Construction Safety Orders, Division of Industrial Safety, State of California.
 - 2. California Department of Transportation Traffic Manual.

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:
1. The CONTRACTOR shall comply with the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the OWNER and shall be in possession of the OWNER's written acceptance of the CONTRACTOR's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared by a civil or structural engineer licensed in the State of California.
 2. Copy of the excavation permit issued by the California Department of Industrial Safety.
 3. Samples of imported material. Samples shall be submitted in accordance with SSPWC, Subsection 306-3.7.
 4. Such other samples of materials as the CONSTRUCTION MANAGER may require.

1.6 SOIL TESTING

- A. General: All soils testing shall be done in accordance with SSPWC, Section 211, and by a testing laboratory of the OWNER's choice at the OWNER's expense. Provide the Resident Engineer a minimum 24 hours advance notice of any Work which shall require testing and sampling as specified herein.
- B. Compaction Tests: Where soil material is required to be compacted to a percentage of maximum density, the maximum density shall be determined in accordance with the requirements of SSPWC, Subsection 211-1. In case the tests of the fill or backfill show non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and shall be at the CONTRACTOR's expense.

PART 2 – PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

- A. General: Fill and backfill material shall consist of select material obtained from the excavation, imported material, bedding material, or unclassified material. The CONTRACTOR shall import at his expense materials in excess of the approved material obtained from excavation as required to complete the fill, backfill, and grading WORK as indicated.
- B. Select Material: Select material shall be free of biodegradable materials, vegetation, organic matter, debris, rocks larger than 6 inches in diameter and other unsuitable material, and shall have an expansion index less than 30 (less than 20 for footings and floor slabs) as determined by IBC Standard No. 29-2. Not less than 70% by weight of

material shall pass a standard uniform ¾" sieve and less than 40% shall pass the #200 sieve. Select material shall be approved by the CONSTRUCTION MANAGER. (It should be noted the site consists of fill underlain by the Ardath Shale Formation. Soil materials generated from excavations in the Ardath Shale Formation are not considered suitable for use as compacted Select Material.)

- C. Imported Material: Imported material shall conform to the same specifications as select material defined above. Imported material placed in areas to be planted shall be able to support normal plant growth. Obtain approval by the CONSTRUCTION MANAGER prior to transporting imported material.
- D. Bedding Material: Onsite materials are not suitable for pipe zone bedding material. The pipe zone is defined as the area extending from the bottom of the trench to a minimum 12" above top of pipe.

For pipe other than PVC, the pipe zone bedding material shall be clean, free draining sand or crushed rock. Sand should be free of clay, organic matter and other deleterious materials and conform to the following gradations:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
½ inch	100
#4	75-100
#16	35-75
#50	10-40
#200	0-10

Crushed rock shall conform to ¾" crushed rock gradation per Greenbook Section 200-1.2.

For PVC or plastic pipe, the pipe zone bedding material shall be per SSPWC Section 217-2.4.

Crushed rock pipe zone material shall be wrapped in geotextile filter fabric, Mirafi 140N, or approved equal.

- E. Unclassified Material: Unclassified material shall conform to SSPWC, Subsection 300-4.
- F. Structure Backfill Material: Use Select Material. Material shall also have a sand equivalent of not less than 20.
- G. Retaining Wall Backfill Material: Onsite soils are not suitable for wall backfill materials, therefore, granular and non-expansive import backfill materials shall be used for this purpose. Backfill material shall have not less than 70% by weight pass a standard uniform ¾" sieve and less than 40% shall pass the #200 sieve. Expansion index shall be less than 20. Material shall not contain any organic debris, rocks or hard lumps greater than 6", or deleterious materials.

2.2 ROCK PRODUCTS

- A. Rock products, consisting of crushed rock, rock dust, gravel, sand, and stone for riprap shall be clean, hard, sound, durable, uniform in quality and free of disintegrated

material, organic matter, oil alkali, or other deleterious substance, and shall, unless otherwise specified, conform with the requirements of SSPWC, Subsection 200-1.

2.3 UNTREATED BASE MATERIALS

- A. Untreated base materials shall conform with the requirements of SSPWC, Subsection 200-2.
- B. Materials for use as untreated base or subbase shall be:
 - 1. Crushed Aggregate Base

2.4 TOPSOIL

- A. Topsoil shall be designated as Class A (imported), Class B (selected), or Class C (unclassified), and shall conform with the requirements of SSPWC, Subsection 800-1.1. The CONSTRUCTION MANAGER shall determine the suitability of topsoil prior to use.

2.5 GEOTEXTILE FABRIC

- A. Trench geotextile fabric shall be Mirafi 140N or approved equal.
- B. Structure geotextile fabric shall have the following properties:

Fabric Property	Min. Certified Values	Test Method
Grab Tensile Strength	300 lb	ASTM D 4632
Grab Tensile Elongation	35% Max	ASTM D 4632
Burst Strength	600 psi	ASTM D 3786
Trapezoid Tear Strength	120 lb	ASTM D 4533
Puncture Strength	130 lb	ASTM D 4833

PART 3 – EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall perform earthwork as necessary to complete the WORK as shown on the Contract Drawings and specified herein. The CONTRACTOR shall take the necessary precautionary measures to prevent dust or other nuisances which might be created by reason of his activities. The necessary precautionary measures shall conform to the requirements of SSPWC, Subsection 7-8. The requirements specified in Subsection 7-8 shall be extended to include paved surfaces.
- B. All types of earthwork, including trench, structural and general excavation, fill, backfill and compaction, shall conform to applicable requirements of the SSPWC Section 300, and to the requirements specified herein.
- C. Pre and post construction surveys shall be conducted by the CONTRACTOR to document existing site conditions and assure his construction activities do not cause settlement.

3.2 SITE PREPARATION

- A. Areas to be excavated, filled, graded, and to be occupied by permanent construction or embankments shall be prepared by clearing and grubbing. Clearing and grubbing shall conform to the applicable requirements of SSPWC, Subsection 300-1.

3.3 EXCAVATION

- A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. Unless otherwise directed, the removal of said materials shall conform to the lines and grades shown. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures for the removal or exclusion of water. Excavations shall be sloped or otherwise supported in a safe manner in accordance with the rules, orders, and regulations of the Division of Industrial Safety of the State of California.
- B. Unclassified Excavation: Unclassified excavation shall consist of all excavation, including roadways, unless separately designated.
 - 1. Unsuitable material shall be excavated and disposed of in accordance with the requirements of SSPWC, Subsection 300-2.2.
 - 2. Wet material, if unsatisfactory for the specified use on the project solely because of high moisture content, may be processed to reduce the moisture content, or may be required to be removed and replaced with suitable material in accordance with the requirements of SSPWC, Subsection 300-2.2.2.
 - 3. The removal and disposal of slide and slipout material shall be in accordance with SSPWC, Subsection 300-2.4.
 - 4. Excavation slopes shall be finished in conformance with the lines and grades shown, and in accordance with SSPWC, Subsection 300-2.5.
 - 5. Surplus material shall be disposed of off-site, and in accordance with SSPWC, Subsection 300-2.6.
- C. Structure Excavation: Structure excavation shall consist of the removal of material for the construction of buildings, vaults, slabs on grade, retaining walls, or other structures, and shall be in accordance with SSPWC, Subsection 300.
 - 1. Cofferdams for foundation construction shall be constructed in accordance with SSPWC, Subsection 300-3.2.
 - 2. The treatment of foundation material shall be in accordance with SSPWC, Subsection 300-3.3.
 - 3. Structures shall be founded on firm native soils or approved compacted materials.
 - 4. Structure Over-Excavation: If loose or soft soils are encountered at the bottom of the structure excavation, the loose or soft material shall be removed and replaced with $\frac{3}{4}$ " crushed rock materials wrapped in geotextile fabric.

D. Underground Conduit Excavation:

1. General: Excavation for underground conduits shall be in accordance with SSPWC, Subsection 217, 306 and the requirements contained herein. Except as otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the CONTRACTOR, The maximum width at the top of the pipe shall be equal to the outside diameter of the pipe plus 24 inches for pipe diameters less than 18 inches.
2. Bracing Excavations: The manner of bracing excavations shall be as set forth in the rules, orders and regulations of the Division of Industrial Safety of the State of California, and in accordance with the requirements of SSPWC, Subsection 306-4.
3. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required.
4. Open Trench: The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is less. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. Barricades and warning lights conforming to requirements set forth in the California Department of Transportation Traffic Manual shall be provided and maintained.
5. Trench Over-Excavation: If loose or disturbed soils are encountered at the trench bottom, it shall be overexcavated. If trenches require to be over-excavated, they shall be excavated to the depth required, and then backfilled with pipe bedding material to the grade of the bottom of the pipe.
6. Where pipelines are to be installed in embankment fills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
7. Trenched excavations located within a horizontal distance from any structures of equal or less than the depth of the excavation shall be limited to 10-foot open sections at a time. Adjacent structures should be periodically inspected for signs of distress. Continued field surveys shall be performed to check and document any movement resulting from the construction activities. In the event that distress or settlement is noted an investigation shall be performed and appropriate corrective measures shall be taken to protect the structures from any further distress/movements.

E. Over-Excavation Ordered by CONSTRUCTION MANAGER:

1. Trenches shall be over-excavated beyond the depth shown when required by the CONSTRUCTION MANAGER. Such over-excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the pipe with pipe bedding material. All work specified in this Section shall be

performed by the CONTRACTOR at no additional cost to the OWNER when the over-excavation ordered by the CONSTRUCTION MANAGER is less than 6 inches below the limits shown. When the over-excavation ordered by the CONSTRUCTION MANAGER is 6 inches or greater below the limits shown, additional payment will be made to the CONTRACTOR for that portion of the work which is located below said 6-inch distance.

F. Over-Excavation not Ordered or Indicated:

1. Any over-excavation carried below the grade ordered or indicated shall be backfilled to the required grade with the specified material and compacted. Such work shall be performed by the CONTRACTOR at no additional cost to OWNER.

H. Excavation in Vicinity of Trees:

1. Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without written permission of the CONSTRUCTION MANAGER. Trees shall be supported during excavation by means previously reviewed by the CONSTRUCTION MANAGER.

I. Rock Excavation:

1. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.
2. Said rock excavation shall be performed by the CONTRACTOR; provided that should the quantity of rock excavation be affected by any change in the scope of the WORK, an appropriate adjustment of the contract price will be made.

3.4 FILL AND BACKFILL

A. General:

1. Fill and Backfill shall be placed in accordance with the applicable provisions of SSPWC, Section 300, and the requirements stated herein. The CONTRACTOR should expect at some of the sites that imported backfill will be required due to unsuitable existing materials.
2. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has been properly cured in accordance with the requirements of Section 03300 and 03310 and has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.
3. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall not be placed until all water is removed from the excavation.

B. Placing and Spreading of Materials:

1. Materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted, each layer shall not exceed 6 inches in thickness. Flooding and jetting methods are not allowed.
2. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Bedding materials shall be brought up evenly around the pipe so that when compacted, the material will provide uniform bearing and side support.
3. Where the material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
4. Where the material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

C. Compaction Requirements

1. Compaction tests shall be performed in accordance with SSPWC, Subsection 211-2.
2. The relative compaction of fill, backfill, and base material shall be in accordance with SSPWC, Section 300, with the following exceptions:
 - a. Subgrade where trench has been overexcavated: 95 percent
 - b. One foot layer of crushed aggregate backfill in overexcavated trench. Where trench is overexcavated more than 2 feet, minimum of 2 layers shall be compacted: 95 percent
 - c. Pipe zone for flexible rigid pipe: 95 percent
 - d. Fill beneath structures, including water containing structures 95 percent
 - e. Backfill around underground structure: 90 percent
 - f. Trench, upper 24" below pavement: 95 percent

D. Unclassified Fill:

1. All fill shall be of unclassified material unless separately designated. Construction of unclassified fill, including preparing the area on which fill is to be placed, and the depositing, conditioning, and compacting of fill material shall be in accordance with SSPWC, Subsection 300-4.

E. Structure Backfill:

1. Backfill at structures shall be select material placed in accordance with SSPWC, Subsections 300-3.5 and 300-4.5.

F. Underground Conduit Backfill:

1. Bedding around pipe shall be bedding material placed in accordance with the requirements of SSPWC, Subsection 217 and 306.
2. Backfill above pipe shall be considered as starting 1 foot above the pipe or conduit, or at the subgrade for cast-in-place or precast structures such as manholes, transition structures, junction structures, vaults, and valve boxes.
3. Backfill at underground conduits shall be select material placed and densified according to SSPWC, Subsection 217 and 306.

3.5 PREPARATION OF SUBGRADE UNDER IMPROVEMENT

- A. The preparation of subgrade for pavement, curbs and gutters, driveways, sidewalks and other roadway structures shall be in accordance with SSPWC, Subsection 301-1.

3.6 UNTREATED BASE

A. Spreading and Compacting:

1. Aggregate base material shall be spread and compacted in accordance with SSPWC, Subsection 301-2.

****END OF SECTION****

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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 reservoir, 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 City of San Diego Supplement Amendments (WHITEBOOK).
- 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. International 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 reservoir 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 OWNER.
- C. Pipeline pressure tests will include the following tests:
 - 1. Air test of double welded lap joints.
 - 2. Hydrostatic pressure test of the complete pipeline, in segments as required to match pipe pressure class.

3.2 AIR TEST

- A. All double welded lap joints shall be pressure tested to a minimum of 40-psi air pressure for a period of 10 minutes per AWWA C206. No air leakage will be allowed.
- B. Any joints which leak shall be repaired and retested.

3.3 HYDROSTATIC TESTING OF POTABLE WATER PIPELINES

- A. Hydraulic testing of potable water pipelines shall be performed in accordance with the

applicable sections of SSPWC Subsection 306-8, Prefabricated Pressure Pipe. 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.
- D. The maximum allowable leakage for distribution and transmission pipelines shall be as indicated in SSPWC Subsection 306-8.9. 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 OWNER will make 24-hour chlorine residual tests. The OWNER will notify the CONTRACTOR of the chlorine test result. Chlorinated water shall be retained in the pipeline for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.
- D. Repetition of Test: The disinfection testing procedure shall be repeated if the initial

tests fail to produce satisfactory results. Two consecutive satisfactory test results shall be required after any unsatisfactory test. The tablet method shall not be used for repeated disinfection.

- E. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.
- F. Final Flushing: Final Flushing shall be done by the CONTRACTOR after he has been notified of a satisfactory chlorine residual test by the OWNER. After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for the intended use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water at no additional cost to the OWNER.
- G. Disinfection of Connections: Pipe and appurtenances used to connect the newly installed water main shall also be disinfected in accordance with AWWA C651.
- H. Neutralization of Chlorinated Water: Neutralizing and disposing of chlorinated water shall be in accordance with Appendix "B" of AWWA Standard C651.

3.5 PREPARATION PRIOR TO DISINFECTION OF RESERVOIR

- A. Remove all scaffolding, planks, tools, rags, and other material not a permanent part of the Reservoir.
- B. The Reservoir 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 RESERVOIR

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

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

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 Reservoir shall be partially filled with water to a depth of approximately one foot.

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 Reservoir 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 OWNER's responsibility.
- B. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be reflashed and will be resampled and retested. If counts from analysis of the second samples exceed the criteria in Standard methods, the pipe shall be re-disinfected and will be resampled and retested until satisfactory results are obtained. The CONTRACTOR shall be responsible for all repeat bacteriological testing costs.

3.8 TESTING OF SEWERS AND STORM DRAINS

- A. Gravity sewers and storm drains shall be tested for leakage in accordance with the requirements of SSPWC Subsection 306-7, Prefabricated Gravity Pipe.

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SECTION 02800

HIGH SECURITY STEEL FENCE AND GATES

PART 1 -- GENERAL

1.1 WORK INCLUDED

The CONTRACTOR shall provide all labor, materials and appurtenances necessary for installation of the steel corrugated pale security fence system defined herein at the Soledad Reservoir Site.

1.2 RELATED WORK

Section 03310 – Cast in Place Site Work Concrete
Section 11156 - Motor-Operated Gates for Vehicle Access

1.3 SYSTEM DESCRIPTION

The manufacturer shall supply a total steel ornamental pale high security fence system. The system shall include all components (i.e., pales, rails, posts, gates and hardware) required.

1.4 QUALITY ASSURANCE

The CONTRACTOR shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.5 REFERENCES

- ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- ASTM D523 - Test Method for Specular Gloss.
- ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.6 SUBMITTAL

The manufacturer's submittal package shall be provided prior to installation.

1.7 PRODUCT HANDLING AND STORAGE

Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.8 PRODUCT WARRANTY

All structural fence components (i.e. rails, pales, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 15 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

1.9 MEASUREMENT AND PAYMENT

Steel Fence and pedestrian gates will be measured parallel to the ground slope along the line of the completed fence, deducting the width of double gates and paid at the unit price shown in the bid schedule under bid item "Steel Fencing".
Double gates will be paid for at the unit price shown in the bid schedule under "Double Access Gates".

PART 2 - MATERIALS

2.1 MANUFACTURER

The steel ornamental pale high security fence system shall conform to Ameristar Impasse II Gauntlet 2-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma or approved equal.

2.2 MATERIAL

- A. Steel material for fence framework (i.e., corrugated pales, rails and posts), when galvanized prior to forming, shall conform to the requirements of ASTM A924/A924M, with a minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- B. Material for corrugated pales shall be a nominal 2.75" x .75" x 14 Ga. The cross-sectional shape of the rails shall conform to the manufacturer's rail design a nominal 2" x 2" x 11 Ga. Pre-drilled holes in the rail shall be spaced 6" on center, providing a pale airspace of no greater than 3.25". Tamperproof fasteners shall be used to fasten each pale to rail at every intersection. Posts shall conform to the manufacturer's I-Beam design with a nominal 3" x 2.75" x 12 Ga. for fence panel heights up to & including 8' height and/or I-Beam design with a nominal 4" x 2.75" x 11 Ga. for fence heights greater than 8' up to 10' panel height. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION

- A. Pales, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept tamperproof security fasteners. Post flange shall be pre-punched to accept rail to post attachment. Post web shall be punched providing a clear opening for

interior of rails to align throughout the entire system for affixing conduit, video cabling, IDS wiring, and other components for a complete systems integration. Rails shall be attached to post flange providing a bracket-less design at each intermediate post.

- B. The manufactured galvanized framework shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/wash, an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be (specify Black, Bronze, White, or Desert Sand). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.
- C. Completed panels shall be capable of supporting a 400 lb. load (applied at midspan) without permanent deformation. Panels shall be biasable to a 30° change in grade.
- D. Swing gates shall be fabricated using 2” sq. x 12ga rail, 2” sq. x 12ga. gate ends, and 2.75” x .75” x 0.075 pales. Gates that exceed 6’ in width will have a 2” sq. x 11ga. intermediate upright. All rail and upright intersections shall be joined by welding. All pale and rail intersections shall also be joined by welding.
- E. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48” width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5” x 6” footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5” - 1.375”) and vertical (0 - .5”). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

PART 3 - EXECUTION

3.1 PREPARATION

All new installation shall be laid out by the CONTRACTOR in accordance with the construction plans.

3.2 FENCE INSTALLATION

Fence post shall be spaced according to Table 3, plus or minus ¼”. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to the line and end posts with fasteners supplied by the manufacturer. Attachment to corner post shall be made using brackets and fasteners supplied by the manufacturer (See Figure 1). Posts shall be set in concrete footers (520-C-3250) having a minimum depth of 36”.

3.3 FENCE INSTALLATION MAINTENANCE

When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching

fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Manufacturer spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-manufacturer parts or components will negate the manufactures' warranty.

3.4 GATE INSTALLATION

Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

3.5 CLEANING

The CONTRACTOR shall clean the jobsite of excess materials.

Table 1 – Minimum Sizes for Posts				
<u>Fence Posts (Nominal)</u>		<u>Panel Height</u>		
3" x 2.75" x 12 Ga. I-Beam		Up to & Including 8' Height		
4" x 2.75" x 11 Ga. I-Beam		Over 8' Height up to & including 10' Height		
<u>Gate Leaf</u>	<u>Gate Height</u>			
	<u>Up to & Including 6'</u>	<u>Over 6' Up to & Including 8'</u>	<u>Over 8' Up to & Including 10'</u>	<u>Over 12'</u>
Up to 4'	3" x 12Ga.	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
4' 1" to 6'	3" x 12Ga.	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
6' 1" to 8'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"	6" x 3/16"
8' 1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"	6" x 3/16"
10' 1" to 12'	6" x 3/16"	6" x 3/16"	6" x 3/16"	8" x 1/4"
12' 1" to 16'	6" x 3/16"	6" x 3/16"	8" x 1/4"	8" x 1/4"

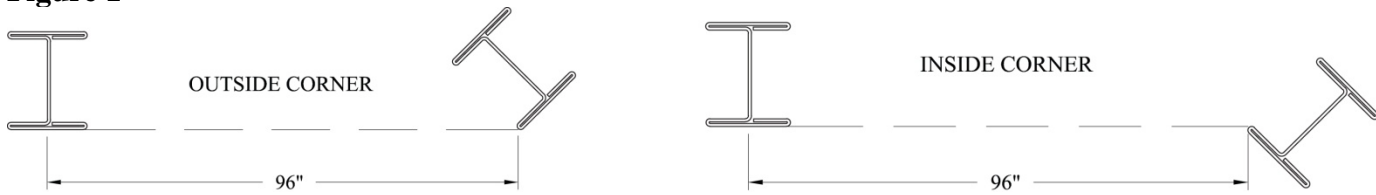
Table 2 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).

Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).
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Table 3 – Post Spacing		
Span	8' Nominal (95" Rail)	
	Line & End Posts	
Post Size	3" x 2.75" x 12 Ga. I-Beam	4" x 2.75" x 11 Ga. I-Beam
Post Settings ± 1/4" O.C.	96"	96"

**For Corner Posts see Figure 1*

Figure 1



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SECTION 02936

TREE PROTECTION

PART 1 - - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees that are affected by execution of the Work.

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by the average of the smallest and largest diameters at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.

B. Tree-Protection Zone: Area surrounding existing trees to be protected during construction, as indicated on Drawings.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:

1. Organic Mulch: 1-pint (0.5-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.

2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.

3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Tree Pruning and Maintenance Schedule: Verify trees to remain that are affected by construction, and submit written schedule detailing scope and extent of tree pruning, and description of on-going tree maintenance during all phases of construction.

D. Qualification Data: Submit Certificates for qualified arborist and tree service firm.

E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

- G. Existing Conditions: Photo Document existing trees indicated to remain, establishing a record of preconstruction conditions, for use in documenting consequential damage caused by construction activities.
 - 1. Use sufficiently detailed photographs.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

- A. Arborist Qualifications: Licensed arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: A tree service firm that has successfully completed tree and plant protection similar to that required for this Project and will assign a qualified arborist to Project site during execution of the Work.
- C. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

1.6 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Erection of sheds or structures.
 - 4. Impoundment of water.
 - 5. Excavation or other digging unless otherwise indicated.
 - 6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Topsoil complying with ASTM D 5268 containing organic matter plus sand, silt, and clay particles; friable, pervious, and a darker shade of brown than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter; free of weeds, roots, toxic or non-soil materials.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees consisting of one of the following:
 - 1. Type: Bark chips, natural color (not dyed).
 - 2. Particle Size Range: 3 inches (76 mm) max., 1/2 inch (13 mm) min.
- C. Protection-Zone Fencing:
 - 1. Chain-Link Protection-Zone Fencing: To be 6 feet tall, Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - 2. Plywood Protection-Zone Fencing: Plywood to be 6 feet tall, framed with four 2-by-4-inch (50-by-100-mm) rails, with 4-by-4-inch (100-by-100-mm) preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart. Plywood and Lumber: Comply with requirements in Section 06 10 53 "Miscellaneous Rough Carpentry."
 - 3. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm).
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering @ 3-inch- (75-mm-) high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees and vegetation to remain. Tie a 1-inch blue-vinyl tape around tree trunk at 54 inches above the ground.

- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting.
- C. Mulch areas inside tree-protection zones @ 3-inch average thickness. Do not place mulch within 3' of tree trunk.

3.3 TREE AND PLANT PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 3. Access Gates: Install as required; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Design Build Team and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 00 00 "Earthwork."

- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist
 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 4. Cover exposed roots with burlap and water regularly.
 5. Backfill as soon as possible according to requirements in Section 31 00 00 "Earthwork."
- B. Root Pruning at Edge of Protection Zone: Prune roots flush with the edge of the protection zone, by clean cuts to the depth of required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 1. Prune trees to compensate for root loss caused by damaging or cutting root system. Do not break or chop branches, use only sharp clean pruning tools.
 2. Provide subsequent maintenance during Contract period as directed by arborist. Prune trees according to ANSI A300 (Part 1).
 3. Do not apply pruning paint to wounds.

- B. Chip removed branches and dispose of them off-site.

3.7 REGRADING

- A. Maintain existing grade within tree protection zone at all times during and after construction.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Design Build Team.

1. Submit details of proposed root cutting and tree and shrub repairs.
2. Have arborist perform the root cutting, branch pruning, and damage repair of trees.
3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
4. Perform repairs within 24 hours.

- B. Tree Replacement: Remove and replace trees that are more than 25 percent dead or in such unhealthy condition that they are incapable of resuming normal growth patterns.

1. Provide one new tree of 8-inch (150 mm) caliper size for each tree deemed to need replacement.

- C. Soil Aeration: Where directed by the Design Team, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property

****END OF SECTION****

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SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete formwork, bracing, shoring, supports, and false work, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Furnishing, erection, and removal of forms.
 - 2. Shoring and bracing of formwork.
 - 3. Setting of embedded items and pipe sleeves for mechanical and electrical work under direction of respective trade.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03290 Joints in Concrete Structures
 - 3. Section 03300 Cast-in-Place Concrete
 - 4. Section 03315 Grout

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 City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. APA PS 1 U.S. Product Standard for Concrete Forms, Class I
 - 2. ALSC PS 20 American Softwood Lumber Standard
 - 3. ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials
 - 4. ACI 347 Guide to Formwork for Concrete

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall, in accordance with the requirements in Section 01300 - Submittals, submit the following.

1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
 2. Form gaskets.
- B. The CONTRACTOR shall provide concrete construction joints and expansion joints of the types and locations indicated on the Drawings. The CONTRACTOR shall submit shop drawings showing the proposed location and type of required construction for any joints not shown on the Drawings, and the sequence of forming and concrete placing operations.
- C. Forms and false work to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads shall be 100 psf.
- 1.5 QUALITY ASSURANCE
- A. The CONTRACTOR shall comply with the requirements of California Division of Occupational Health and Safety Construction Safety Orders Section 1717 and OSHA Part 1926, Section 1926.701 that apply to the Work of this Section. The CONTRACTOR shall prepare and maintain at least one copy of the required drawings at the site. Design of the structures shown on the Drawings does not include any allowance or consideration for imposed construction loads. Shoring and falsework design drawings and calculations shall be stamped and signed by a professional engineer registered in the State of California. The CONTRACTOR shall provide forms, shoring and falsework adequate for imposed live and dead loads, including equipment, height of concrete drop, concrete and foundation pressures, stresses, lateral stability, and other safety factors during construction.
- B. Tolerances: The CONTRACTOR shall employ formwork complying with ACI 347 Guide to Formwork for Concrete, except as exceeded by the requirements of regulatory agencies, or as otherwise indicated or specified. The CONTRACTOR shall design and construct formwork to produce finished concrete conforming to tolerances given in ACI 117.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Except as otherwise expressly accepted by the CONSTRUCTION MANAGER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:
- | | | |
|----------------|---|---|
| Walls | - | Steel or plywood panel |
| Columns | - | Steel, plywood or fiber glass |
| Roof and floor | - | Plywood |
| All other work | - | Steel panels, plywood or tongue and groove lumber |
- B. Form materials which may remain or leave residues on or in the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 FORM AND FALSE WORK MATERIALS

- A. Materials for concrete forms, formwork, and false work shall conform to the following requirements:
1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.3 FORM TIES

- A. Form ties with integral water stops shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be Standard Snap Tie by Dayton Superior; Masco Snaapties by the Masons Supply Company; or approved alternate.
- B. Form ties for water-retaining structures shall have integral water stops. Removable taper ties may be used when approved by the CONSTRUCTION MANAGER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. Use Taper Ties by Dayton Superior; Masco Taper Tie by the Masons Supply Company; or approved alternate.

2.4 FORM COATING

- A. Non-grainraising and nonstaining resin or polymer type that will not leave residual matter on surface of concrete or adversely effect bonding to concrete of paint, plaster, mortar, protective coatings, waterproofing or other applied materials. Coatings containing mineral oils, paraffins, waxes or other nondrying ingredients, are not permitted. For concrete surfaces contacting portable stored water, use only coatings and form-release agents that are completely nontoxic.

2.5 FORM JOINT SEALERS

- A. For joints between form panels, use resilient foam rubber strips, non-hardening plastic-type caulking compound free of oil, or waterproof pressure-sensitive plastic tape of minimum 8 mil thickness and 2 inches width. For form tie holes, use rubber plugs, plastic caulking compound, or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at no increased cost to the OWNER. The CONTRACTOR shall provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, false work, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement.

Such lines shall be used by CONTRACTOR's personnel and by the CONSTRUCTION MANAGER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.

- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

3.2 FORM DESIGN

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the CONSTRUCTION MANAGER. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the CONSTRUCTION MANAGER.

3.3 CONSTRUCTION

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the CONSTRUCTION MANAGER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and the bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Form Ties:

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03300 - Cast-in-Place Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.
2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

D. Embedded Items:

1. Before the placement of concrete within the forms, each trade having embedded items, including water stops within the forms and affected by the pour, shall certify that all items are properly located and braced. This certification shall be provided by the CONTRACTOR to the CONSTRUCTION MANAGER at least 24 hours in advance of placement.

3.4 EMBEDDED PIPING AND ROUGH HARDWARE

- A. The CONTRACTOR shall consult with all trades which require openings for the passage of pipes, conduits and other inserts, and properly and accurately install the necessary pipe sleeves, anchors, or other required inserts, and properly size the equipment pads. The CONTRACTOR shall reinforce openings as indicated and required. The CONTRACTOR shall locate conduits or pipes so as not to reduce the strength of the construction, and in no case, place pipes, other than conduits, in a slab 4-1/2 inches or less in thickness. The CONTRACTOR shall not embed conduit having an outside diameter greater than 1/3 of the thickness of the slab in a concrete slab, nor place conduit below bottom reinforcing steel or over top reinforcing steel. Conduits may be embedded in walls, provided they are not larger in outside diameter than 1/3 the thickness of the wall, are not spaced closer than three diameters on center, and do not impair the strength of the structure. The CONTRACTOR shall support embedded pipes and conduits independently from reinforcing steel in a manner to prevent metallic contact, and thereby, prevent electrolytic deterioration. The CONTRACTOR shall place embedded pipes and conduits as nearly as possible to the center line of the concrete section. The CONTRACTOR shall submit all conduit, piping and other wall penetrations, reinforcements and anchor bolt sizing and locations for review and approval.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms for supported slab, but not shoring, shall remain in place until test cylinders for the roof concrete attain a minimum

compressive strength of 75 percent of the 28-day strength specified in Section 03300 - Cast-in-Place Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the CONSTRUCTION MANAGER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the CONSTRUCTION MANAGER.

3.6 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the CONSTRUCTION MANAGER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the CONSTRUCTION MANAGER.

3.7 MAINTENANCE OF FORMS

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the CONSTRUCTION MANAGER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.8 FALSE WORK

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all false work, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the California Division of Industrial Safety.

3.9 REMOVAL OF SHORING AND FALSE WORK

- A. The CONTRACTOR shall not remove shoring and false work until 21 days after concrete placement, or concrete has attained at least 90 percent of the 28 day design compressive strength as demonstrated by control test cylinders, but not sooner than 14 days.

3.10 LOAD RESTRICTION

- A. The CONTRACTOR shall not impose construction, equipment or permanent loads on columns, supported slabs, or supported beams until concrete has attained the 28 day design compressive strength.

****END OF SECTION****

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SECTION 03200

REINFORCEMENT STEEL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete reinforcement steel, welded wire fabric, couplers, concrete inserts, wires, clips, supports, chairs, spacers, and other accessories, complete, all in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Furnishing and placing bar and mesh reinforcing for cast-in-place concrete.
 - 2. Furnishing reinforcing steel bars for masonry, including delivery to the site.
 - 3. Submittals.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03290 Joints in Concrete Structures
 - 3. Section 03300 Cast-in-Place Structural Concrete
 - 4. Section 03315 Grout
 - 5. Section 04232 Reinforced Concrete Block Masonry

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- C. Commercial Standards (Current Edition):
 - 1. ACI 117 Specification for Tolerances for Concrete Construction and Materials
 - 2. ACI 315 Details and Detailing of Concrete Reinforcement
 - 3. ACI 318 Building Code Requirements for Structural Concrete
 - 4. CRSI MSP Concrete Reinforcing Steel Institute Manual of Standard Practice
 - 5. WRI Manual of Standard Practice for Welded Wire Fabric
 - 6. AWS D1.4 Structural Welding Code - Reinforcing Steel
- D. ASTM Standards in Building Codes (Current Edition):

1. ASTM A82 Steel Wire, Plain, for Concrete Reinforcement
2. ASTM A185 Steel Welded Wire Reinforcement, Plain, for Concrete
3. ASTM A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
4. ASTM A706 Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
5. ASTM A775 Epoxy-Coated Reinforcing Steel Bars

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel before fabrication in accordance with the requirements of Section 01300 - Submittals.
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of reinforcement steel for fabrication and erection shall conform to ACI 315, ACI 301 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.

1.5 QUALITY ASSURANCE

- A. If requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall furnish samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests due to material failing initial tests shall be paid by the CONTRACTOR.

PART 2 - PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. Materials which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 REINFORCEMENT STEEL

- A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
 1. Bar reinforcement shall conform to the requirements of ASTM A615 for Grade 60 Billet Steel Reinforcement or as otherwise indicated.
 2. All welded reinforcement, specifically detailed or otherwise indicated, shall be low-alloy grade 60 deformed bars conforming to the requirements of ASTM A706.
 3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.
 4. Tie wire shall be Annealed Steel, 14 gauge minimum.

- B. Accessories:
 - 1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice, Chapter 3, including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/16-inch minimum thickness of plastic coating which extends at least 2-inch from the concrete surface. Plastic shall be gray in color.
 - 2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
 - C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A775.
- 2.3 MECHANICAL COUPLERS
- A. Mechanical couplers shall not be used.
- 2.4 WELDED SPLICES
- A. Welded splices shall not be used.
- 2.5 EPOXY GROUT
- A. Epoxy for grouting reinforcing bars shall be Hilti HIT-HY 200 or as specified on the Plans.

PART 3 - EXECUTION

3.1 GENERAL

- A. All reinforcement steel, welded wire fabric and other appurtenances shall be fabricated, and placed in accordance with the requirements of the California Building Code and the supplementary requirements indicated herein.

3.2 FABRICATION AND DELIVERY

- A. The CONTRACTOR shall conform to CRSI MSP, Chapters 6 and 7, except as otherwise indicated or specified. The CONTRACTOR shall bundle reinforcement and tag with suitable identification to facilitate sorting and placing, and transport and store at site so as not to damage material. The CONTRACTOR shall keep a sufficient supply of tested, approved, and proper reinforcement at site to avoid delays.
- B. Bending and Forming: The CONTRACTOR shall bend bars of indicated size and accurately form in accordance with the requirements of ACI 315 and ACI 318 to shapes and lengths indicated on drawings and required by methods not injurious to materials. The CONTRACTOR shall not heat reinforcement for bending. Bars with kinks or bends not scheduled will be rejected.
- C. Fabricating tolerance: All fabrication of reinforcing bars shall meet the requirements of ACI 117.
- D. Reinforcing Bars for Masonry: The CONTRACTOR shall detail and fabricate bars at the shop, ready for installation by masons.

3.3 PLACING

- A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. Limitations on the use of bar support materials shall be as follows:
 - 1. Concrete Dobies: Permitted at all locations except where architectural finish is required.
 - 2. Wire Bar Supports: Permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 - 3. Plastic Bar Supports: Permitted at all locations except on grade.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Bars additional to those shown which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at no additional cost to the OWNER.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the CBC.
- 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. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPLICES

- A. Splicing shall be in accordance with ACI 318, unless otherwise noted on Drawings.

- B. Vertical Bars. Except as specifically detailed or otherwise indicated, splicing of vertical bars in concrete is not permitted, except at the indicated or approved horizontal construction joints or as otherwise specifically detailed.
- C. Horizontal Bars. Except as specifically detailed or otherwise indicated, splicing of horizontal bars in concrete is not permitted.

3.5 ADDITIONAL REINFORCING

- A. The CONTRACTOR shall provide additional reinforcing bars at sleeves and openings as indicated on Drawings.

3.6 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****

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SECTION 03280

JOINTS IN SITE WORK CONCRETE

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing expansion joints, construction joints, weakened plane control joints and contact joints in concrete pavement, sidewalk, curb and gutter.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03310 Cast-in-Place Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) of International Code Council (ICC) as adopted by the City of San Diego Municipal Code.
- C. ASTM Standards in Building Codes (Current Edition):
 - 1. ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
 - 2. ASTM D994 Preformed Expansion Joint Filler for Concrete (Bituminous Type)

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals.
 - 1. Placement shop drawings showing the location and type of all joints.
 - 2. Catalog cuts and samples of the preformed expansion joint filler material, including complete product data.

1.5 OPERATION AND MAINTENANCE INFORMATION

- A. The following operation and maintenance related information shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Manufacturer's certification indicating that the preformed expansion joint material meets or exceeds the requirements of the Specifications.

PART 2 - PRODUCTS

2.1 PREMOLDED JOINT FILLER

- A. Premolded joint filler shall be in conformance with SSPWC Subsection 201-3.2 and shall be either Preformed Expansion Joint Filler (ASTM D994) or Nonextruding and Resilient Filler (ASTM D1751) as indicated.

2.2 STEEL BARS AND DOWELS

- A. Steel bars used in construction joints or contact joints shall conform to SSPWC Subsection 201-2.2.

2.3 CONCRETE CURING COMPOUND

- A. Curing compound shall comply with SSPWC Subsection 201-4.

PART 3 - EXECUTION

3.1 EXPANSION JOINTS

- A. Expansion joints in concrete pavement shall be constructed in accordance with SSPWC Subsection 302-6.5.3 except that the configuration of the joint shall be as indicated on the drawings.
- B. Expansion joints in concrete curbs, sidewalk and gutter shall comply with SSPWC Subsection 303-5.4.2 except that the joint configuration shall be as indicated on the drawings.

3.2 CONSTRUCTION JOINTS

- A. Construction joints in concrete pavement shall comply with SSPWC Subsection 302-6.5.2.

3.3 WEAKENED PLANE CONTROL JOINTS

- A. Weakened plane joints in concrete pavement shall comply with SSPWC Subsection 302-6.5.4 except that the configuration of the joint shall be as indicated on the drawings.
- B. Weakened plane joints in concrete curbs, sidewalks and gutters shall comply with SSPWC Subsection 303-5.4.3 except that the joint configuration shall be as indicated on the drawings.

3.4 CONTACT JOINTS

- A. Contact joints in concrete pavement shall be made by placing fresh concrete against hardened concrete. A moisture barrier consisting of curing compound conforming to SSPWC Subsection 201-4 shall be applied to the face of any contact joint and allowed to dry prior to placing fresh concrete against that joint face. This provision is also applicable to existing portland cement concrete pavement not constructed as part of the Work performed under the contract. Application rate shall be as specified in SSPWC Subsection 302-6.6 for the compound used.

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SECTION 03290

JOINTS IN CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide joints in concrete at the locations indicated, complete, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 03300 Cast-in-Place Concrete
 - 4. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- C. Federal Specifications (Current Edition):
 - 1. TT-S-0227E(3) Sealing Compound, elastomeric type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures
 - 2. SS-S-210A Sealing compound, preformed plastic, for expansion joints and pipe joints
- D. U.S. Army Corps of Engineers Specifications:
 - 1. CRD-C572 Polyvinylchloride Waterstop
- E. ASTM Standards in Building Codes (Current Edition):
 - 1. ASTM A775 Epoxy-Coated Steel Reinforcing Bars
 - 2. ASTM C920 Elastomeric Joint Sealants
 - 3. ASTM D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
 - 4. ASTM D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

5.	ASTM D638	Test Method for Tensile Properties of Plastics
6.	ASTM D746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
7.	ASTM D747	Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
8.	ASTM D1056	Flexible Cellular Materials - Sponge or Expanded Rubber
9.	ASTM D1752	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
10.	ASTM D2000	Classification System for Rubber Product in Automotive Applications
11.	ASTM D2240	Test Method for Rubber Property -- Durometer Hardness
12.	ASTM D2241	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

1.4 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of a bonding agent as indicated.
- B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided unless otherwise indicated on the Drawings.
- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours; the joint shall be formed as indicated. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise indicated, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop.
- D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is filled afterward with a joint sealant material as specified.

1.5 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals:
 - 1. Waterstops: Before production of the required materials, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be provided under this contract. The balance of

the material to be used under this contract shall not be produced until after the CONSTRUCTION MANAGER has reviewed the qualification samples.

2. Joint Sealant: Before ordering the sealant material, the CONTRACTOR shall submit sufficient data to show general compliance with the requirements of the Contract Documents.
3. Before the sealant is used on the job, the CONTRACTOR shall submit certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements.
4. Shipping Certification: The CONTRACTOR shall furnish written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.
5. Joint Location: The CONTRACTOR shall submit placement shop drawings showing the location and type of all joints for each structure.

1.6 QUALITY ASSURANCE

- A. Waterstop Inspection: All waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without the CONTRACTOR having made prior arrangements with the CONSTRUCTION MANAGER to provide for the required inspections. Not less than 24 hours' notice shall be given to the CONSTRUCTION MANAGER for scheduling such inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at no increase in cost to the OWNER.
- C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
 1. Offsets at joints greater than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15% of material thickness at any point, whichever is less.
 4. Misalignment of joint which result in misalignment of the waterstop in excess of 2 inch in 10 feet.
 5. Porosity in the welded joint as evidenced by visual inspection.
 6. Bubbles or inadequate bonding which can be detected with a penknife test. If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.

1.7 WARRANTY

- A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation for all joints provided against faulty and/or incompatible materials and workmanship, along with a statement that it agrees to repair or replace, to the satisfaction of the OWNER and at no additional cost to the OWNER, any defects that appear during the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All joint materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use.

2.2 PVC WATERSTOPS

- A. General: Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and submit to the CONSTRUCTION MANAGER current test reports and a written certification that the material to be shipped meets the physical requirements outlined in the U.S. Army Corps of Engineers Specification CRD-C572 and those listed herein.
- B. Flatstrip and Center-Bulb Waterstops: At no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8 inch. Flatstrip and center-bulb waterstops shall be manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., Lynbrook, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or approved alternate. Prefabricated factory made joint fittings shall be used at all intersections of the flatstrip and center-bulb type waterstops.
- C. Other Types of Waterstops: When other types of waterstops not listed above are required and indicated, they shall be subjected to the same requirements as those listed herein.
- D. Waterstop Testing Requirements: When tested in accordance with the standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1,750	D638, Type IV
Ultimate Elongation-min (%)	350	D638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D746
Stiffness in Flexure-min (psi)	400	D747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1,500	D638, Type IV
Ultimate Elongation-min (%)	300	D638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (%) +0.25/-0.10	-----	
Change in Durometer, Shore A	+5	D2240

Finish Waterstop

Tensile Strength-min (psi)	1,400	D638, Type IV
Ultimate Elongation-min (%)	280	D638, Type IV

2.3 JOINT SEALANT

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 degrees F and 50% relative humidity):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	200 psi, minimum
Ultimate Elongation (ASTM D 412)	400%, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray

C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be two-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ASTM C920 or Federal Specification TT-S-0227 E(3) for two-part material, as applicable.
2. For vertical joints and overhead horizontal joints, only "nonsag" compounds shall be used; all such compounds shall conform to the requirements of ASTM C920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ASTM C920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing nontracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.

D. All sealants, wherever shown, or required hereunder shall be PSI-275 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation, or approved alternate.

E. Sealants for nonwaterstop joints in concrete shall conform to the requirements of Section 07920 - Sealants and Calking.

2.4 JOINT MATERIALS

- A. Bearing Pad: Bearing pad to be neoprene conforming to ASTM D2000 BC 420, 40 durometer hardness unless otherwise indicated.
- B. Neoprene Sponge: Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D1056, Type 2C3-E1.
- C. Joint Filler:
 - 1. Joint filler for expansion joints in water holding structures shall be neoprene conforming to ASTM D1056, Type 2C5-E1.
 - 2. Joint filler material in other locations shall be of the preformed nonextruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D1752 for Type I, except as otherwise indicated.

2.5 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25% at 8 psi. The rod shall be 1/8 inch larger in diameter than the joint width except that a 1 inch diameter rod shall be used for a 3/4 inch wide joint.

2.6 BOND BREAKER

- A. Bond breaker shall be Silcoseal Select as manufactured by Nox-Crete, Omaha, Nebraska; Easy-Lift E as manufactured by Atlas, San Diego, California; Select Cure CRB as manufactured by Select Products Co., Upland, California, or approved alternate. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.7 SLIP DOWELS

- A. Slip dowels in joints shall be A36 smooth epoxy-coated bars, as indicated on the Drawings, and epoxy coated conforming to ASTM A775.

2.8 PVC TUBING

- A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D2241.

PART 3 - EXECUTION

3.1 GENERAL

- A. Waterstops of the type indicated shall be embedded in the concrete across joints as indicated. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.

- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60% of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than two ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated before placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
- D. Where a centerbulb waterstop intersects and is jointed with a noncenterbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

- A. **Setting Waterstops:** To eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions shall be made to support and anchor the waterstops during the progress of the Work and to ensure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working it in the vicinity of all joints.
- B. In placing flat-strip waterstops in the forms, a means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise indicated, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. In placing center-bulb waterstops in expansion joints, the center-bulb shall be centered on the joint filler material.

- D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- E. Joint Location: Construction joints, and other types of joints, shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints, of any type, shall be submitted for acceptance by the CONSTRUCTION MANAGER.
- F. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.
- G. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
- H. The space so formed shall be filled with a joint sealant material as specified. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel, unless otherwise indicated on Drawings.
- I. Construction Joint Sealant: Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with grooves, which shall be filled with a construction joint sealant. The material used for forming the grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the grooves, before application of the sealant.
- J. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant before application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.
- K. All sealant shall be installed by a competent waterproofing specialty CONTRACTOR who has a successful record of performance in similar installations. Before Work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- L. Thorough, uniform mixing of two-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- M. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be resealed with the indicated joint sealant. All costs of

such removal, joint treatment, resealing, and appurtenant work shall be at no additional cost to the OWNER.

N. Bentonite Waterstop

1. Bentonite waterstop is not permitted.

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SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide finished structural concrete, complete, in accordance with the Contract Documents.
- B. The following types of concrete are covered in this Section:
 - 1. Structural Concrete: Concrete to be used in all cases except where noted otherwise in the Contract Documents.
 - 2. Lean Concrete: Concrete to be used for thrust blocks, anchor blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the Drawings as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.
- C. The term "hydraulic structure" used in these Specifications refers to environmental engineering concrete structures for the containment, treatment, or transmission of water, or other fluids.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 Concrete Formwork
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 03280 Joints in Site Work Concrete
 - 4. Section 03290 Joints in Concrete Structures
 - 5. Section 03315 Grout

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. Federal Specifications
 - UU-B-790A (1) (2) Building Paper, Vegetable Fiber (Kraft, Water-proofed, Water Repellant and Fire Resistant)
 - 2. Commercial Standards:
 - ACI 117 Tolerances for Concrete Construction and Materials

- | | |
|------------|---|
| ACI 214R | Guide to Evaluation of Strength Test Results of Concrete |
| ACI 301 | Specifications for Structural Concrete |
| ACI 304.2R | Placing Concrete by Pumping Methods |
| ACI 305R | Guide to Hot Weather Concreting |
| ACI 309R | Guide for Consolidation of Concrete |
| ACI 315 | Details and Detailing of Concrete Reinforcement |
| ACI 318 | Building Code Requirements for Structural Concrete |
| ACI 350 | Code Requirements for Environmental Engineering Concrete Structures |
3. ASTM Standards in Building Codes:
- | | |
|-----------|---|
| ASTM C31 | Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C33 | 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 C42 | Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| ASTM C88 | Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| ASTM C94 | Ready Mixed Concrete |
| ASTM C136 | Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C138 | Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete |
| ASTM C143 | Test Method for Slump of Hydraulic Cement Concrete |
| ASTM C150 | Portland Cement |
| ASTM C156 | Test Method for Water Loss [from Mortar Specimen] Through Liquid Membrane Forming Curing Compounds for Concrete |
| ASTM C157 | Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete |
| ASTM C192 | Practice for Making and Curing Concrete Test Specimens in the Laboratory |
| ASTM C231 | Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C289 | Test Method for Potential Alkali Silica Reactivity of Aggregates (Chemical Method) |

- ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C494 Chemical Admixtures for Concrete
- ASTM C1077 Practice for Agencies Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Testing Agency Evaluation
- ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- ASTM D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- ASTM E119 Test Methods for Fire Tests of Building Construction and Materials

1.4 CONTRACTOR SUBMITTALS

- A. Mix Designs: Within 14 days of starting the work, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER, for review, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed and 28-day compression test reports for each class and type of concrete specified herein in accordance with Section 01300 - Submittals.

The mix designs shall be checked and certified to conform to these specifications by an independent testing laboratory acceptable to the CONSTRUCTION MANAGER to be in conformance with these Specifications. All costs related to such checking and testing shall be borne by the CONTRACTOR at no increased cost to the OWNER.

- B. Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.
- C. The CONTRACTOR shall provide the following submittals in accordance with ACI 301:
 1. Mill tests for cement.
 2. Admixture certification. Chloride ion content must be included.
 3. Aggregate gradation and certification.
 4. Materials and methods for curing.
- D. The CONTRACTOR shall provide catalog cuts and other manufacturer's technical data demonstrating compliance with the requirements indicated and specified herein for all admixtures used in the concrete mix design.

1.5 QUALITY ASSURANCE

A. General:

1. Tests on component materials and for compressive strength of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C143.
2. The cost of all laboratory tests requested by the CONSTRUCTION MANAGER on cement, aggregates, and concrete, will be borne by the OWNER. However, the CONTRACTOR will be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The laboratory must meet or exceed the requirements of ASTM C1077.
3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall provide assistance to the CONSTRUCTION MANAGER in obtaining samples, and disposal and cleanup of excess material.

B. Field Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the CONSTRUCTION MANAGER to ensure continued compliance with these Specifications. Each set of test specimens will be a minimum of five cylinders.
2. Compression test specimens for concrete shall be made in accordance with section 9.2 of ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
3. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days and two at 28 days. The remaining cylinders will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality, Mixing, and Placing," and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any three consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.

5. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no increase in cost to the OWNER.
- D. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.
1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

<u>Item</u>	<u>Tolerance</u>
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 3-inch; In 20 feet or more: 2-inch
Variation from the level or from the grades shown.	In 10 feet: 3-inch; In 20 feet or more: 2-inch
Variation from the plumb	In 10 feet: 3-inch; In 20 feet or more: 2-inch
Variation in the thickness of slabs and walls.	Minus 3-inch; Plus 2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 3-inch

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. General:

1. All materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use within 30 days of application.
2. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.

B. All materials furnished for the Work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.

C. Storage of materials shall conform to the requirements of Section 2.5 of ACI 301 or the SSPWC.

D. Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand Portland cement conforming to ASTM C150 for Type II/V, including Table 2 optional requirements. A minimum of 85 percent of cement

by weight shall pass a 325 screen. A single brand of cement shall be used throughout the Work, and before its use, the brand shall be acceptable to the CONSTRUCTION MANAGER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the CONSTRUCTION MANAGER if requested regarding compliance with these Specifications.

2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. Agricultural water with high total dissolved solids concentration (over 1,000 mg/l) shall not be used.
3. Aggregates shall be obtained from pits acceptable to the CONSTRUCTION MANAGER, shall be nonreactive, and shall conform to ASTM C33. 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 1 inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the Paragraph in Part 2 entitled "Trial Batch and Laboratory Tests" for the use of the size groups.
 - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM 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 C33, 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 C33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
 - e. When tested in accordance with ASTM C33, 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 C33, 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 C33, 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 C94.
5. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior

end result, discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be nontoxic after 30 days.

a. Set controlling and water reducing admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, effect water reduction, and increase workability. The addition of an admixture shall be at no increase in cost to the OWNER. The use of an admixture shall be subject to acceptance by the CONSTRUCTION MANAGER. Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER. Admixtures specified herein shall conform to the requirements of ASTM C494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

- (1) Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER.
- (2) Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as Plastocrete by Sika Corporation; Pozzolith 300R by BASF Admixture Systems; Daratard by Grace Construction Products; or approved alternate shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a noncorrosive set accelerating admixture such as Plastocrete 161FL by Sika Corporation; Pozzutec 20 by BASF Admixture Systems; Daraset by Grace Construction Products; or approved alternate shall be used.
- (3) Normal range water reducer shall conform to ASTM C494, Type A. WRDA 79 by Grace Construction Products; Pozzolith 322-N by BASF Admixture Systems; Plastocrete 161 by Sika Corporation; or approved alternate. 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 C494, Type F or G. Daracem 100 or WDRA 19 by Grace Construction Products; Sikament FF or Sikament 86 by Sika Corporation; Rheobuild 1000 or Rheobuild 716 by BASF Admixture Systems; or approved alternate. 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 \pm 2 inch before adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested before each day's operation of the job site system.
- (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: Flyash shall conform to the requirements of ASTM C618, Class F and Loss of Ignition shall not exceed 4 percent. Flyash, as a percentage by weight of total cementitious materials, shall not exceed 15 percent.

2.2 CURING MATERIALS

- A. Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C309:
1. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Spartan Cote Cure-Seal Hardener by Dayton Superior; Super Rez Seal by Euclid Chemical Company; MB-429 as manufactured by BASF Building Systems; or approved alternate. Water based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent based compound. Water based curing compounds shall be Aqua Resincure by Dayton Superior; Aqua-Cure VOX by Euclid Chemical Company; Masterkure-W by BASF Building Systems; or approved alternate.
 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 C156 shall not exceed 0.055 grams per square centimeter of surface.
 3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
 4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
 5. Curing mats for use in Curing Method 6 as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
 6. Evaporation retardant shall be a material such as Confilm as manufactured by BASF Building Systems; Eucobar as manufactured by Euclid Chemical Company; or approved alternate.

2.3 NONWATERSTOP JOINT MATERIALS

- A. Materials for nonwaterstop joints in concrete shall conform to the following requirements:
1. Preformed joint filler shall be a nonextruding, resilient, bituminous type conforming to the requirements of ASTM 1751.
 2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.
 3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and

contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the CONSTRUCTION MANAGER.

2.4 MISCELLANEOUS MATERIALS

- A. Dampproofing agent shall be an asphalt emulsion, such as MasterSeal 610 (formerly Hydrocide 600) by BASF Building Systems; Damp-proofing Asphalt Coating by Euclid Chemical Company; Sealastic by W. R. Meadows Inc., or approved alternate.
- B Bonding agents shall be epoxy adhesives conforming to the following products for the applications specified:
 - 1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concsive Liquid (LPL), as manufactured by BASF Building Systems; BurkEpoxy MV as manufactured by Dayton Superior; or approved alternate.
 - 2. For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel as manufactured by Sika Corporation; BurkEpoxy NS as manufactured by Dayton Superior; Concsive Paste (LPL) as manufactured by BASF Building Systems; or approved alternate.

2.5 CONCRETE DESIGN REQUIREMENTS

- A. Mix Design.
 - 1. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch.

In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. In mix designs, the percentage of sand of the total weight of fine and coarse aggregate shall not exceed 41 for hydraulic structures or 50 for all other structures, unless noted otherwise. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. All changes shall be subject to review by the CONSTRUCTION MANAGER.

- 2. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

	Min 28-Day Compressive Strength	Max Size Aggregate	Minimum Cement per cu yd	Max W/C Ratio
<u> Type of Work </u>	<u> (psi) </u>	<u> (in) </u>	<u> (lb) </u>	<u> (by weight) </u>
Structural Concrete:				

Roof, floor slabs, columns, walls and all other concrete items not specified elsewhere	4,000	1	650	0.42
12" and thicker walls, slabs on grade and footings, with written approval of the CONSTRUCTION MANAGER	4,000	1	650	0.42
Pea Gravel Mix. Thin sections and areas with congested reinforcing, at the CONTRACTOR's option and with the written approval of the CONSTRUCTION MANAGER for the specific location	4,000	3/8	752	0.40
Maximum fine aggregate 43% by weight of aggregate				
Other Concretes:	3,000	1	520	0.50
Lean concrete	2,000	1-1/2"	376	0.60

Note: The CONTRACTOR is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.

3. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the CONTRACTOR shall be entitled to no additional compensation because of such changes.

B. Consistency

1. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C143. The slumps shall be as follows:

<u>Part of Work</u>	<u>Slump (in)</u>
All concrete, unless note otherwise	3 inches \pm 1 inch
With high range water reducer added	7 inches \pm 2 inches
Ductbanks	5 inches \pm 1 inch

C. Trial Batch and Laboratory Tests

1. Before placing any concrete, a testing laboratory designated by the CONSTRUCTION MANAGER will prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the CONTRACTOR. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the CONTRACTOR's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch will be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain six compression test specimens from each batch. The cost of not more than three laboratory trial batch tests for each specified concrete strength will be borne by the OWNER but the CONTRACTOR shall furnish and deliver the materials in steel drums at no cost. Any additional trial batch testing required shall be performed by the CONTRACTOR at no additional cost to the OWNER.
2. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C192 and ASTM C39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
3. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C136. Values shall be given for percent passing each sieve.
4. In lieu of trial batch and laboratory tests specified in this Section, the CONTRACTOR may submit previously-designed, tested, and successfully-used concrete mixes, using materials similar to those intended for this project, together with a minimum of three certified test reports of the 28-day strength of the proposed concrete mix.

D. Measurement of Cement and Aggregate

1. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment acceptable to the CONSTRUCTION MANAGER.
2. Weighing Tolerances:

<u>Material</u>	<u>Percent of Total Weight</u>
Cement	1
Aggregates	3
Admixtures	3

F. Measurement of Water

1. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the CONSTRUCTION MANAGER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive

quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

2.6 READY MIXED CONCRETE

- A. At the CONTRACTOR's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C94, including the following supplementary requirements.
- B. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the Work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the CONSTRUCTION MANAGER in accordance with Subsection 03300-1.4B.
- G. The use of nonagitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the CONSTRUCTION MANAGER.

2.7 FLOOR HARDENER (SURFACE APPLIED)

- A. Surface hardener shall be a light reflective nonoxidizing metallic aggregate dry shake surface hardener.
 - 1. Surface hardener shall be premeasured, premixed and packaged at the factory.
 - 2. Apply surface hardener at the rate of 1.8 to 2.5 lb per square foot
 - 3. Surface hardener shall be Lumiplate, by BASF Building Systems, or approved alternate.

- B. Curing Compound shall meet the moisture retention requirements of ASTM C309 and surface hardener manufacturer's recommendations.
- C. Monomolecular Film: Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by surface hardener manufacturer.

PART 3 - EXECUTION

3.1 PROPORTIONING AND MIXING

- A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 "Production of Concrete" of ACI 301.
- C. Slump: Maximum slumps shall be as specified herein.
- 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, before the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the CONSTRUCTION MANAGER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. The joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints, and the joint surface shall be coated with an epoxy-bonding agent, unless indicated otherwise, before the new concrete is placed.
- C. 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.
- D. 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.
- E. All inserts or other embedded items shall conform to the requirements herein.

- F. 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.
- G. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the CONSTRUCTION MANAGER.
- H. 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.
- I. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported before placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- J. 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.
- K. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- L. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Nonconforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no additional expense to the OWNER.
- C. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the CONSTRUCTION MANAGER. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing at least 24 hours in advance of placement of any concrete.
- D. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal

shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

- E. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the CONSTRUCTION MANAGER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.
- 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 F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.
- H. Hot Weather Placement:
 - 1. Placement of concrete shall conform to ACI 305R – Guide to Hot Weather Concreting, and the following.
 - 2. Only set retarding admixture shall be used in concrete when air temperature is expected to be consistently over 80 degrees F.
 - 3. The maximum temperature of concrete shall not exceed 90 degrees F immediately before placement.
 - 4. From the initial placement to the curing state, concrete shall be protected from the adverse effect of high temperature, low humidity, and wind.

3.4 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.
- C. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.
- D. Aluminum conduits for conveying the concrete shall not be permitted.
- E. Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the Work shall be acceptable to the CONSTRUCTION MANAGER. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days for hydraulic structures and 3 days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for all other structures.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4 inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2 inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309R) high speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the CONSTRUCTION MANAGER.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated.
 Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is

placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Part 1, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. Formed Surfaces: No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as specified or as shown.
 - 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

<u>Area</u>	<u>Finish</u>
-------------	---------------

Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs which are water bearing with slopes 10 percent and less	U3
Sloping slabs which are water bearing with slopes greater than 10 percent	U4
Slabs 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

3.8 ARCHITECTURAL FINISH

A. General: Architectural finishes shall be required only where specifically called out on the Drawings. In all other cases, the paragraph above, entitled Finishing Concrete Surfaces, shall apply.

1. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and all form-tie holes filled as indicated herein.
2. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
3. All architecturally treated concrete surfaces shall conform to the accepted sample required herein in texture, color, and quality. It shall be the CONTRACTOR's responsibility to maintain and protect the concrete finish.

B. Smooth Concrete Finish:

1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one part Portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 2 gray and 2 white Portland cement, as determined by the CONSTRUCTION MANAGER. White Portland cement shall be Atlas white, or equal. Calcium chloride in the amount of 5 percent by volume of the cement shall be used in the brush coat. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all the surface grout had been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.
2. Cleaning operations for any given day shall be terminated at panel joints. It is essential that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.
3. In the event that improper manipulation results in an inferior finish, rub such inferior areas with carborundum bricks.

4. Before beginning any of the final treatment on exposed surfaces, treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the CONSTRUCTION MANAGER and shall preserve said trial area undisturbed until the completion of the job.

3.9 CURING AND DAMPPROOFING

- A. General: All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the Work, and described in detail in the following paragraphs:

<u>Surface to be Cured or Dampproofed</u>	<u>Method</u>
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4
Floor slabs on grade	4
Slabs not on grade	4
Meter Vault and Pipe Trench slabs 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 1 days after placement of concrete.
- E. Method 4: The surface shall be sprayed with a liquid curing compound.
 1. It shall be applied in accordance with the manufacturer's printed instructions in such a manner as to cover the surface with a uniform film which will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just before the placing of new concrete.
 4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.
 5. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the previously coated panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
 6. Before final acceptance of the Work, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage surface finish.
- F. Method 6: This method applies to both walls and slabs.
1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days beginning immediately after the concrete has reached final set or forms have been removed.
 2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
 3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing by wind or any other causes and to be substantially in contact with the concrete surface. All edges shall be continuously held in place.
 4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
 5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4, herein.
 6. Dispose of excess water from the curing operation to avoid damage to the Work.
- G. Dampproofing: The exterior surface of all buried walls shall be dampproofed as follows:
1. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in two coats. The first coat shall be diluted to 2% strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as specified herein.

2. As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, apply additional whitewash.

3.10 PROTECTION

- A. Protect all concrete against injury until final acceptance by the OWNER.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.11 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50 degrees F.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, the specified 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the CONSTRUCTION MANAGER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.

- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white Portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Before filling any structure with water, all cracks that may have developed shall be "vee'd" and filled with construction joint sealant for water-bearing structures conforming to the materials and methods specified in Section 03290 - Joints in Concrete Structures. This repair method shall be done on the water bearing face of members. Before backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill material, shall be filled with nonshrink grout. Where a face of the member is exposed to view, the nonshrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the paragraph in Part 3 entitled "Treatment of Surface Defects."
3. Small holes through all other concrete members shall be filled with nonshrink grout, with exposed faces treated as above.

B. Patching Large Holes:

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.

2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless shown.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have an extrudable, polyurethane-based type waterstop material placed around the perimeter of the hole as specified in the Section 03290 - Joints in Concrete Structures, unless there is an existing waterstop in place.

3.14 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time before the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR's expense.

****END OF SECTION****

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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.
- B. Sitework concrete includes curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground duct bank encasement, and all concrete Work indicated to be sitework concrete.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03290 - Joints in Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) of International Code Council (ICC) as adopted by the City of San Diego Municipal Code.

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in compliance with the requirements of Section 01300 - Submittals and in compliance with SSPWC Section 201.

1.5 TESTS

- A. Tests on component materials, for the compressive strength of concrete, and for construction tolerances shall be performed in accordance with the requirements of SSPWC Section 201.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Concrete component materials, including curing materials and joint materials shall be in accordance with SSPWC Subsections 201-1, 201-4, and 201-5.

2.2 FORMWORK

- A. Concrete formwork shall comply with SSPWC Subsection 204-1.

2.3 STEEL REINFORCEMENT

- A. Reinforcing steel shall conform to SSPWC Subsection 201-2 and section 03200.

PART 3 - EXECUTION

3.1 GENERAL

- A. Proportioning and mixing, preparation of surfaces for concreting, handling, transporting and placing concrete, finishing and curing concrete surfaces and related procedures shall be performed in accordance with SSPWC Subsections 303-1 and 303-5.

****END OF SECTION****

SECTION 03315

GROUT

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide grout in accordance with the Contract Documents.
- B. The following types of grout shall be covered in this Section:
 - 1. Nonshrink Grout: This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.
 - 2. Cement Grout.
 - 3. Epoxy Grout.
 - 4. Pump and Motor Grout.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03300 Cast-in-Place Structural Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. Commercial Standards :
 - CRD-C621 Corps of Engineers Specification for Non-shrink Grout
 - 2. ASTM Standard in Building Codes:
 - ASTM C109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
 - ASTM C531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - ASTM C579 Test Methods for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - ASTM C827 Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixture
 - ASTM C881 Epoxy Resin Base Bonding System for Concrete

ASTM C882	Test for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear
ASTM C884	Test Method for Thermal Compatibility between Concrete and an Epoxy-Resin Overlay
ASTM D638	Test Methods for Tensile Properties of Plastics.
ASTM D696	Test Method for Coefficient of Linear Thermal Expansion of Plastics Between 30°C and 30°C With a Vitreous Silica Dilatometer

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements indicated herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of nonshrink and epoxy grout used in the Work in accordance with the requirements of Section 01300 - Submittals.

1.5 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the CONSTRUCTION MANAGER to ensure continued compliance with these Specifications. The specimens will be made by the CONSTRUCTION MANAGER.
2. Compression tests and fabrication of specimens for cement grout will be performed as specified in ASTM C109 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. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the OWNER.
4. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining specimens for testing. However, the CONTRACTOR shall be responsible, without additional cost to the OWNER, for the cost of any additional tests and investigation on work performed which does not comply with the Specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.

- B. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 - Cast-in-Place Concrete, except as modified herein and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.1 CEMENT GROUT

- A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 2,000 psi.

- B. Cement grout materials shall be as specified in Section 03300 - Cast-in-Place Structural Concrete.

2.2 PREPACKAGED GROUTS

A. Nonshrink Grout:

1. Nonshrink grout shall be a prepackaged, inorganic, nongas-liberating, nonmetallic, cement-based grout requiring only the addition of water. The manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout indicated herein shall be that recommended by the manufacturer for the particular application.
2. Class A nonshrink grouts shall have a minimum 28 day compressive strength of 5,000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD-C 621.
3. Class B nonshrink grouts shall have a minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD-C 621.
4. Acceptable Manufacturers are HUB Patch All 20, RapidSet Mortar Mix, HUB Construction Grout, RapidSet Cement, or approved alternate.
5. Application:
 - a. Class A nonshrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is indicated; except, for the applications for Class B nonshrink grout and epoxy grout indicated herein. Class A nonshrink grout may be used in place of Class B nonshrink grout for all applications.
 - b. Class B nonshrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, nonshrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any nonreactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be as indicated on the Drawings.
2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.

4. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C579, 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 C531 or ASTM D696.
7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications in the Contract Documents where grout type is not specifically indicated.
8. For crack repair, the CONTRACTOR shall use pressure injection epoxy grout as recommended by manufacturer and approved by the CONSTRUCTION MANAGER.

C. Grout for Pumps and Motors:

1. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:
 - a. Creep shall be less than 0.005 in/in when tested by ASTM C881 method. The test shall be at 70 degrees F and 140 degrees F with a load of 400 psi.
 - b. Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17×10^{-6} in/in/degree F when tested by ASTM C531.
 - c. The compressive strength shall be a minimum of 12,000 psi in 7 days when tested by ASTM C579 Method 8, modified.
 - d. Bond strength of grout to Portland cement concrete shall be greater than 2,000 psi when using ASTM C882 test method.
 - e. Grout shall pass the thermal compatibility test when overlaid on Portland cement concrete using test method ASTM C884.
 - f. Tensile strength and modulus of elasticity shall be determined by ASTM D638. The tensile strength shall not be less than 1,700 psi and the modulus of elasticity shall not be less than 1.8×10^6 psi.
 - g. Peak exothermic temperature shall not exceed 110 degrees F when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 90 minutes.
 - h. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150 degrees F, with a load of 2,000 psi.

2. Primer, if required, shall conform to the written recommendations of the grout manufacturer.
3. Surface preparations shall conform to the written recommendations of the grout manufacturer.
4. Placement and Curing:
 - a. Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.
5. Grout shall be Escoweld, Chockfast Red Epoxy Grout as manufactured by Philadelphia Resin Corp., Five Star DP Epoxy Grout as manufactured by Five Star Products, Inc., Sikadur 42, or approved alternate.

2.3 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 - Cast-in-Place Structural Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.4 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as indicated in Section 03300 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.
- B. The manufacturer of Class A nonshrink grout and epoxy grout shall provide onsite technical assistance to CONTRACTOR upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the CONSTRUCTION MANAGER.
- D. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- E. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

3.2 GROUTING PROCEDURES

- A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
 - B. Base Plate Grouting:
 - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum 1-inch thickness of grout or a thickness as indicated on the Drawings.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the CONSTRUCTION MANAGER, alternate grouting methods shall be submitted for acceptance by the CONSTRUCTION MANAGER.
- 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 03400
PRECAST CONCRETE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide precast concrete work, complete, in accordance with the Contract Documents.
- B. This Section covers the design, fabrication, delivery, and installation of all precast boxes, manholes, and structural concrete including connections.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03290 Joints in Concrete Structures
 - 3. Section 03300 Cast-in-Place Structural Concrete
 - 4. Section 03315 Grout
 - 5. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:

1. Commercial Standards:

ACI 117	Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concretes
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
AWS D1.1	Structural Welding Code - Steel
AWS D1.4	Structural Welding Code - Reinforcing Steel
PCI MNL-116	Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
PCI MNL-120	Design Handbook - Precast and Prestressed Concrete

2. ASTM Standard in Building Codes:

ASTM A184	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A185	Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A497	Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A580	Stainless Steel Wire
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C33	Concrete Aggregates
ASTM C127	Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C150	Portland Cement
ASTM C173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C204	Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus
ASTM C231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C311	Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM D2240	Test Method for Rubber Property -- Durometer Hardness

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 - Submittals.
- B. Shop Drawings:
 - 1. Shop drawings shall show details in accordance with ACI 315 and ACI 318 including installation details and design computations.
 - 2. Shop drawings and design computations shall be stamped and signed by a Civil or Structural Engineer registered in the State of California.

3. Shop drawings shall indicate precast unit identification marks, the location of units in the Work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop drawings shall include erection drawings.
- C. Mix Proportions: Before commencing operations a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory.
 - D. Test Reports: Tests for compressive strength of concrete shall be performed by an independent commercial testing laboratory. Copies of test reports including all test data and all test results shall be submitted.
 - E. Certificates of Compliance: Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.
 - F. Manufacturer's Qualifications: Before commencing operations, a statement shall be submitted giving the qualifications of the precast concrete Manufacturer, and evidence that the Manufacturer and plant are PCI certified.
- 1.5 QUALITY ASSURANCE
- A. General Requirements: Design members under direct supervision of a professional Civil or Structural Engineer qualified in design of precast concrete units, registered in the State of California, and conforming to requirements of PCI MNL-116, and to ACI 318.
 1. Precast Manufacturer and erectors shall be qualified in accordance with PCI MNL-116.
 2. Welding shall be in accordance with AWS D1.1, AWS D1.4 and AWS A5.4.
 3. Manufacture, Transportation and Installation: The Manufacturer shall specialize in providing precast products and services normally associated with precast concrete construction, using procedures complying with PCI MNL-116.
 4. Certificate of compliance meeting the requirement of Chapter 17 of the current edition of the California Building Code (CBC) of International Code Council (ICC) as adopted by the City of San Diego Municipal Code and acceptance by the City of San Diego shall be submitted to the OWNER.
- 1.6 DESIGN REQUIREMENTS
- A. Standards and Loads: The precast design and construction shall conform to all applicable loads and standards as specified on the contract drawings.
 - B. Concrete Mix: The concrete mix shall be designed by the Manufacturer and be approved by the CONSTRUCTION MANAGER, to meet or exceed all of the requirements in specification Section 03300.
 - C. Reinforcing Steel: The reinforcing steel shall be designed by the Manufacturer and be approved by the CONSTRUCTION MANAGER, to meet or exceed all of the requirements in specification Section 03200.

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Unless specified otherwise herein, fabrication, handling and erection of precast elements shall be in accordance with the recommendations made by ACI 318 and ACI Committee 533. Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.
- B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.
- C. Precast units shall be stored off the ground in a manner to prevent warpage and shall be protected from weather, marring, and overload. Lifting devices shall have a minimum safety factor of 4.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

- A. Concrete: Concrete in contact with soil or liquids shall be formulated using Type II or Type V portland cement conforming to ASTM C150. Concrete not in contact with soil or liquids may be formulated using Type I or Type III portland cement. Cement shall contain less than 0.60 percent alkalis and shall be from one source throughout the entire project.
- B. Aggregates: Aggregates for normal weight concrete shall conform to ASTM C33 with a maximum size of 3/4 inch.
- C. Water: Water shall be clean, potable, and free from injurious amounts of oil, alkalis, organic materials and other deleterious substances.
- D. Admixture: Admixture shall be Pozzolith 300R by BASF Admixture Systems, Plastocrete by Sika Corporation, or approved alternate. Admixture shall be used in strict accordance with manufacturer's recommendations. Calcium chloride or any admixture containing calcium chloride shall not be used.
- E. Reinforcing Steel: Reinforcing steel shall conform to ASTM A615, including supplementary requirements, and shall be Grade 60 except that bars to be welded shall be ASTM A706.
- F. Molds: Molds shall be designed to withstand high-frequency vibration and to ensure finished units. Material from which molds are to be fabricated shall be wood, steel, concrete, fiberglass, reinforced plastic or wood. The selection of materials for molds shall be at the manufacturer's option. All elements shall be cast in molds of rigid construction, accurate in detail with precise corners and arises, and designed to provide a close control of dimensions and details as indicated on the drawings.

Prior to casting of precast elements, molds shall have all surface joints, radii, corners, etc., filled, ground, filed, straightened or otherwise removed to provide a finished concrete surface that is smooth and dense, free of honeycombing, large air pockets, offsets, sinkages, or other irregularities.

- G. Embedded Items and Anchorage Devices: All embedded items, inserts, and anchorage devices exposed to view, moisture or weather shall be hot-dipped galvanized steel. Anchorage devices shall be fabricated from ASTM A36 steel.
- H. Penetrations: All required penetrations and openings larger than 6-inches in diameter or 6-inches square shall be formed in place at the time of casting. Additional reinforcing shall be added where required to meet loading requirements. Openings and penetrations smaller than 6-inches may be core drilled.
- I. Parting Compound: All molds shall be coated with parting compound to facilitate removal of elements from molds. Parting compound shall be non-petroleum, nonstaining and shall be of a nature and composition not deleterious to concrete.
- J. Manhole Steps: Manhole steps shall be fabricated from ASTM A36 steel and shall be hot dip galvanized.

2.2 ACCESSORIES

- A. Plates, Angles, Anchors, and Studs: Hot dip galvanized ASTM A36.
- B. Reglets: Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion.
- C. Bearing Pads: Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D2240.
- D. Sealant: In accordance with in Section 07920 - Sealants and Caulking.

2.3 FABRICATION

- C. General: Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116. Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the CONSTRUCTION MANAGER upon request.
- D. Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.
- E. Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as shown on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement is permitted. Welding, when allowed, shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.
- D. Adequate reinforcing steel shall be provided to control cracking.
- E. Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during panel construction. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.
- F. Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.

- G. Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.4 FINISH OF PRECAST UNITS

- A. Exposed and Unexposed Faces. Smooth, dense, uniform surface free from blemishes. Defects in unexposed edges shall be repaired as approved.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Casting: Casting shall be accomplished by methods and equipment that are in conformance with generally acceptable systems for this type of Work. All precast concrete shall be manufactured by a plant thoroughly qualified in this type of Work. The manufacturer shall meet all production schedules. Surfaces on which units are cast shall be level and free from any imperfections detrimental to the surface appearance of the finished units. Parting compound shall be applied evenly as per manufacturer's recommendations.

Concrete shall be so handled as to prevent segregation of materials and shall be continuously vibrated during casting, either internally or externally, to achieve proper compaction, finish and distribution of concrete. All precautions must be taken to keep the reinforcing steel in the proper location during placing and consolidation of the concrete. Unless shown otherwise and except at concrete faces exposed to soil or liquids, all reinforcing steel shall have a minimum cover of 3/4 inch. At concrete faces exposed to soil or liquids, cover shall be 1-1/2 inches minimum. Embedded items shall be accurately placed and maintained in their proper location during the casting operation. Special inserts or other devices for handling of panels for the convenience of the manufacturer shall not be exposed to view after members are erected. Embedded anchors, inserts, plates, angles and other cast-in items shall have sufficient anchorage and embedment for design requirements.

Casting, bowing, warpage and dimensional tolerances shall be in accordance with MNL-116.

- B. Curing: All precast units shall be steam cured for a period of at least 12 hours. Fog spraying may be used when reviewed by the CONSTRUCTION MANAGER. Precast elements shall not be removed from molds for a minimum period of 12 hours after casting, or until concrete has attained a minimum compressive strength of 3,500 pounds per square inch, whichever governs. After removal from the forms, curing by steam or fog spraying shall be continued until concrete has attained specified strength and confirmed by standard tests. Curing procedures shall be consistent and uniform throughout the entire project.
- C. Welding: The quality of material and fabrication of all welded connections shall conform to the latest AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings." All weldments shall be made in accordance with the applicable provisions of AWS. All welding, other than tacks, shall be done by certified welders. All units shall be protected from damage by field welding or cutting operations. Noncombustible shields shall be provided as necessary for this purpose.
- D. Joints and Joint Sealants: In all instances, the edges of precast concrete units and of adjacent material shall be sound, smooth, clean and free of all contaminants prior to joint treatment.

Sealant and primer shall be supplied by the same manufacturer and the primer, when required, shall be as recommended for the particular sealant used. All sealant compounds shall be delivered to the job in the manufacturer's original sealed containers with labels intact and shall be

applied in strict accordance with the manufacturer's recommendations. Sealant shall be as specified in specification Section 07920 of these specifications.

3.2 ERECTION

- A. Any errors or misalignment in the structure which would prevent the proper setting of the elements shall be corrected by the CONTRACTOR before the erection is commenced. Erection shall be supervised and performed by workmen skilled in this type of Work. Each element shall be set in the proper position, carefully plumbed and anchored securely to the structural frame. Adjustments or changes in connections which could involve additional stresses in the products or connections shall not be permitted without approval of the CONSTRUCTION MANAGER. All bearing surfaces shall be true to line and grade. Erection tolerances shall be in accordance with MNL-116. All joints shall be uniform and straight.

3.3 CLEANING AND REPAIRING

- A. After installation, precast elements shall be protected from all damage until final acceptance by the CONSTRUCTION MANAGER. Precast units with cracks, spalls, and other defects shall be subject to rejection. Units reviewed for repair shall be repaired to the satisfaction of the CONSTRUCTION MANAGER.

3.4 ALTERNATIVE DESIGN

- A. The CONTRACTOR may offer an alternative design for any precast element. Such design shall be comparable in terms of strength, deflection, finish and all other design criteria indicated. Complete drawings prepared and sealed by a civil or structural engineer registered in the State of California where applicable shall be submitted to the CONSTRUCTION MANAGER for his review in accordance with these Specifications. No alternative design will be permitted unless it has been specifically accepted in writing by the CONSTRUCTION MANAGER. If an alternative design is accepted, all expenses resulting therefrom shall be borne by the CONTRACTOR.

****END OF SECTION****

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SECTION 04232

REINFORCED CONCRETE BLOCK MASONRY

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete masonry and appurtenant Work, complete, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Concrete block masonry.
 - 2. Installing reinforcing steel in masonry.
 - 3. Grout and mortar for masonry.
 - 4. Shoring, bracing and scaffolding incidental to work of this Section.
 - 5. Setting and incorporating into masonry all bolts, anchors, inserts and ledgers.
 - 6. Building in of frames, vents, pipes, conduits and inserts.
 - 7. Continuous inspections, test specimens and samples of material, as specified.
 - 8. Pointing, cleaning and protection.
 - 9. Submittals.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03300 Cast-in-Place Structural Concrete
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 07100 Waterproofing
 - 4. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- B. Commercial Standards (Current Edition)
 - ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
 - ACI 531 Building Code Requirements for Concrete Masonry Structures
- C. ASTM Standards in Building Codes (Current Edition)
 - 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 Concrete Building Brick
 - ASTM C 90 Specification for Load-Bearing Concrete Masonry Units

ASTM C 140	Tests Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	Specification for Aggregate for Masonry Mortar
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 Linear Drying Shrinkage of Concrete Masonry Units
ASTM C 476	Specification for Grout for Masonry
ASTM E 447	Test Methods for Compressive Strength of Masonry Prisms

1.4 CONTRACTOR SUBMITTALS

- A. Samples of concrete masonry unit colors with texture ranges as indicated shall be submitted to the CONSTRUCTION MANAGER for selection of the color in accordance with the requirements of Section 01300 - Submittals. Full size samples of the blocks selected shall be submitted for final approval by the CONSTRUCTION MANAGER after color selection, if requested. If the material indicated is a colored and textured unit, the samples submitted shall be colored and textured units. Samples of mortar colors shall be submitted for color selection by the CONSTRUCTION MANAGER.
- B. A 4-foot minimum square free-standing sample panel shall be prepared for approval by the CONSTRUCTION MANAGER before starting masonry Work and shall remain at the Work site for reference until all masonry Work is completed.

1.5 QUALITY ASSURANCE

- A. Applicable Standards: Concrete masonry shall conform to the CBC and other applicable codes and standards of governing authorities.
- B. All Work shall conform to the standard of quality established by the CONSTRUCTION MANAGER's acceptance of the free-standing sample panel required to be constructed before starting the masonry work.
- C. Concrete block masonry units shall be sampled and tested in accordance with ASTM C 140.
- D. Testing of Mortar and Grout: The CONTRACTOR shall have the mortar and grout tested by a recognized testing laboratory approved by the CONSTRUCTION MANAGER to ensure compliance with the Specifications and the governing codes. Test reports shall be submitted to the CONSTRUCTION MANAGER in accordance with Section 01300 - Submittals.
- E. Tests shall be taken at the following times:
 - 1. At the start of the masonry Work, at least two test samples each of mortar and grout shall be taken on three successive working days.

2. At any change in materials or job conditions, at least two samples of each modified material, grout and mortar shall be tested.
 3. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the CONSTRUCTION MANAGER.
 4. Additional samples and tests may be required whenever, in the judgment of the CONSTRUCTION MANAGER, additional tests (beyond the random tests) are necessary to determine the quality
- F. The costs of tests and test reports, except for additional tests requested by the CONSTRUCTION MANAGER, shall be paid by the CONTRACTOR at no additional cost to the OWNER. The costs of the additional tests and reports, when such reports verify compliance with the Contract Documents, will be paid by the OWNER. When tests or reports do not verify compliance, the cost of all additional tests and reports shall be paid by the CONTRACTOR at no additional cost to the OWNER.
- G. Test samples shall be stored in a moist environment until tested, unless directed otherwise by the CONSTRUCTION MANAGER or the testing laboratory. Tests shall be in accordance with CBC Section 1708.1. The grout and mortar strengths shall be not less than the minimum strengths indicated herein.
- H. Inspection: Continuous inspection by a special inspector approved by the City of San Diego Development Services Department and by the CONSTRUCTION MANAGER will be required where necessary to conform with code requirements. [Costs of special inspection shall be paid for by the CONTRACTOR. Inspection reports shall be submitted.]
- I. Weather Conditions: Concrete masonry units shall not be placed when air temperature is below 40 degrees F and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F in the shade with relative humidity less than 50 percent.
- J. Product Storage: Cement, lime, and other cementitious materials shall be delivered to the site and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Building Code Requirements for Concrete Masonry Structures. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30 pounds per square foot. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

PART 2 -- PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete masonry units shall conform to ASTM C 90, Type I, hollow load bearing units with maximum linear shrinkage of 0.6 percent from standard to oven-dried condition. Units shall be medium weight units unless indicated otherwise.
- B. Concrete masonry units at exterior walls shall be 8-inch by 8-inch by 16-inch, 8-inch by 12-inch by 16-inch or 8-inch by 16-inch by 16-inch modular size, as indicated on the drawings, with smooth, scored and split faces. Off-set cells when called out in the drawings. The color, scoring and finish of concrete masonry units shall be as specified on the Drawings.

- C. Concrete masonry units at interior walls shall be medium weight block 8-inch by 8-inch by 16-inch or 8-inch by 12-inch by 16-inch modular size, as indicated on the drawings, with smooth faces, of color matching the integrally colored block.
- D. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped nonstructural blocks may be constructed by saw cutting. The color and texture of specially shaped blocks shall match that of adjacent units.
- E. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.

2.2 MATERIALS FOR MORTAR AND GROUT

- A. Portland cement shall be Type II, low alkali, conforming to ASTM C 150.
- B. Lime paste shall be made with pulverized quicklime, or with hydrated lime, which shall be allowed to soak not less than 72 hours before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hours and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C 207. Pulverized quicklime shall conform to ANSI/ASTM C 5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.
- C. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.
- D. Water for mixing shall be clear potable water.
- E. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60.
- F. Admixture for mortar shall be BASF Aktiengesellschaft Rheopel Mortar Admixture; Grace Construction Products, W. R. Grace & Co. Conn. Dry-Block Mortar Admixture or approved alternate. The admixture shall not be detrimental to the bonding or help the process of efflorescence.
- G. Admixture for grout shall be Sika Co. Sika Grout Aid; BASF Aktiengesellschaft Pozzoloth or approved alternate.

2.3 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Elastomeric Sealant: Per Section 07920 "Sealants and Caulking."

PART 3 -- EXECUTION

3.1 GENERAL

- A. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

3.2 MORTAR

- A. Mortar for concrete block masonry shall be Type S, with a minimum 28-day compressive strength of 1,800 psi. Proportions shall be one part portland cement, 3- to 2-part lime paste or hydrated lime, and damp, loose sand in an amount (by volume) of not less than 2-3 or more than three times the sum of the volumes of cement and lime used, with the precise amount of water required to produce the required workability and strength.
- B. Mortar color shall match block color.

3.3 GROUT

- A. Grout shall have a minimum 28-day compressive strength of 2,000 psi. Proportions shall be one part portland cement, not more than 1/10-part lime paste or hydrated lime, 2-3 to 3 parts damp, loose sand, not more than two parts pea gravel, and water in the amount necessary to produce a consistency for pouring without segregation of components. Where the grout space is less than 4 inches, pea gravel shall be omitted.
- B. Admixtures may only be used when approved by the CONSTRUCTION MANAGER. When it has been approved for use, it shall be used in accordance with the manufacturer's published recommendations for the grout.

3.4 CONSTRUCTION - GENERAL

- A. All Work shall be performed in accordance with the provisions of the applicable code for reinforced concrete unit masonry.
- B. Set or embed all anchors, bolts, reglets, sleeves, conduits, and other items in Work as required.
- C. All block cutting shall be by machine.
- D. Masonry units shall be supported off ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated into the Work.
- E. All reinforcing steel shall be cleaned of all loose rust and scale, and all oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.
- F. Immediately before starting Work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.
- G. Full mortar joint for first course shall be provided.
- H. Units shall be shoved tightly against adjacent units to assure good mortar bond.
- I. The CONTRACTOR shall provide safe and adequate scaffolding, planking, ladders and/or ramps conforming with all applicable CAL/OSHA State of California Construction Safety Orders.

3.5 MASON'S IRON WORK

- A. The CONTRACTOR shall furnish, set and build into the masonry, all iron work necessary for the masonry construction, and which is enclosed in the masonry.
- B. The CONTRACTOR shall set and build into the masonry all items which are furnished and located by other trades, or indicated on the Drawings, such as bolts and sleeves for securing the work of such other trades, metal attachments, sleeves, inserts and similar items. Setting shall consist of the bedding, or setting in mortar or dry pack, of all items to be set hereunder.

- C. The CONTRACTOR shall build into the masonry all items furnished, located and set by others, such as door frames, vents, conduit, pipes and the like. Building into masonry shall consist of filling-in with mortar or grout around all items to be built into masonry, including hollow metal door frames. The CONTRACTOR shall set and build-in all such items so that there will be no voids anywhere, and so that the items are installed rigid, solid, and held accurately and securely in place.
 - D. The CONTRACTOR shall bear full responsibility for the accurate placement of all mason's iron work. The CONTRACTOR shall fully and solidly grout anchors in place. Unless otherwise noted, the CONTRACTOR shall provide embedment of not less than 2/3 of the wall thickness.
- 3.6 EQUIPMENT
- A. All equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.
- 3.7 MIXING
- A. Mortar shall be mixed by placing 1/2 of the water and sand in the operating mixer, followed by the cement, lime, and remainder of the sand and water. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.
- 3.8 ERECTION OF CONCRETE BLOCK MASONRY
- A. Masonry Work shall be erected in-plane, plumb, level, straight, and true to dimensions shown and executed in accordance with acceptable practices of the trade.
 - B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.
 - C. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be full bedded in mortar. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.
- 3.9 SHORING AND BRACING
- A. All shoring and bracing shall be provided as required for work. Shoring and bracing shall be constructed to required shapes and sizes, capable of supporting and sustaining the loads to which they will be subjected without failure or deflection. Shores and bracing shall be left in place until concrete masonry can safely carry all required live and dead loads.
 - B. Concrete masonry wall shall be adequately braced to withstand all forces to which they will be subjected during construction. Walls are not designed to be self-supporting for lateral loads until attached to floor and roof elements.
- 3.10 JOINTS
- A. Vertical and horizontal joints shall be uniform and approximately 3/8 inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior nonexposed masonry and masonry behind plaster shall have flush joints.
- 3.11 CLEANOUTS

- A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry.
- 3.12 REINFORCEMENT
- A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.
 - B. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.
- 3.13 GROUTING
- A. All cells shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 8-foot lifts.
 - B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.
- 3.14 PROTECTION
- A. Wall surfaces shall be protected from droppings of mortar or grout during construction.
- 3.15 FINISHING AND CLEANING
- A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.
 - B. Finished masonry shall be cleaned and painted 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.

****END OF SECTION****

SECTION 04815

GLASS UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide material and installation of glass unit masonry assemblies in accordance with Contract Documents.
- B. Work Included in this Section:
 - 1. Glass block set in mortar.

1.2 RELATED SECTIONS:

- 1. Section 04232 "Reinforced Concrete Block Masonry"
- 2. Section 05500 "Metal Fabrications"
- 3. Section 07920 "Joint Sealants"

1.3 CONTRACTOR SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Four full glass-block units.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Glass Block: Obtain glass block through single source from single manufacturer.
- B. Source Limitations for Accessory Materials: Obtain each cementitious material and accessory component through single source from single manufacturer and each aggregate from single source or producer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store glass block in unopened cartons on elevated platforms, under cover, and in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store glass-block grid materials in unopened cartons in an enclosed, dry location.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation of glass unit masonry assemblies only when ambient and material temperatures are 40 deg F or higher.
 - 1. Maintain temperature in installation areas at 40 deg F or above for 48 hours after installing.

PART 2 - PRODUCTS

2.1 GLASS BLOCK

- A. Hollow Glass Block: Hollow units made from transparent glass, with manufacturer's standard edge coating.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Pittsburgh Corning Corporation; Thickset 90 Series Decora or comparable product by one of the following:
 - a. Mulia Inc. (Distributed by Glass Blocks Unlimited and Mulia, Inc.).
 - b. Nippon Electric Glass Co., Ltd. (Distributed by Glass Blocks Unlimited and Nippon Electric Glass America, Inc.).
 - c. Oberland Glas AG, Bauglas Div.; Solaris Glasstein (Distributed by Glass Blocks Unlimited and North America Glass).
 - d. Seves (Distributed by Glass Blocks Unlimited, International Product Supply, and Seves North America).
 - e. J. Weck GmbH (Distributed by Glashauss, Inc. and Glass Blocks Unlimited).
 - 2. Glass Color: Colorless.
 - 3. Pattern: Wavy, light-diffusive design on inner faces, and smooth outer faces.
 - 4. Edge-Coating Color: White.
 - 5. Sizes: Manufacturer's standard sizes corresponding to nominal sizes indicated on Drawings.
 - 6. Heavyweight glass providing a STC 50 noise control level.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

- D. Colored Cement Product: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
- E. Aggregate: ASTM C 144, with 100 percent passing No. 8 sieve.
 - 1. For pointing mortar and joints narrower than 1/4 inch, use aggregate graded with 100 percent passing No. 16 sieve.
 - 2. White Aggregates: Natural white sand or crushed white stone.
- F. Water-Repellent Admixture: Manufacturer's standard dry mixture of stearates, water-reducing agents, and fine aggregates intended to reduce capillarity in mortar.
- G. Water-Repellent Admixture for Use with Water Repellent Treated CMU: Liquid polymeric water-repellent mortar admixture that does not reduce flexural bond strength of mortar.
- H. Water: Potable.

2.3 GLASS UNIT MASONRY ACCESSORIES

- A. Panel Reinforcement: Ladder-type units, butt welded, not lapped and welded; complying with ASTM A 951 in straight lengths of not less than 10 feet, and as follows:
 - 1. Exterior Walls: Hot-dip galvanized, carbon-steel wire.
 - 2. Wire Size: W1.7 or 0.148-inch diameter.
 - 3. Width: 2 inches.
 - 4. Spacing of Cross Rods: Not more than 16 inches apart.
- B. Fasteners, General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners at exterior walls and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at interior walls. Select fasteners for type, grade, and class required.
- C. Asphalt Emulsion: Cold-applied asphalt emulsion complying with ASTM D 1187 or ASTM D 1227.
- D. Plastic-Foam Expansion Strips: Polyethylene foam complying with requirements of glass-block manufacturer; 3/8 inch thick.
 - 1. Use plastic-foam expansion strips for all assemblies.
- E. Sealants: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 07920 "Joint Sealants."
- F. Sealant Accessories: Provide sealant accessories, including primers, bond-breaker tape, and cylindrical sealant backing, that comply with applicable requirements in Section 07920 "Joint Sealants."

2.4 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, or antifreeze compounds unless otherwise indicated.

1. Do not use calcium chloride in mortar.
 2. For mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
 3. For pointing mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
 4. Limit cementitious materials in mortar to portland cement and lime.
 5. Do not retemper mortar.
- B. Mortar for Glass Unit Masonry Assemblies: Comply with ASTM C 270, Proportion Specification for Type S mortar.
1. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Mix mortar to produce a stiff but workable consistency that is drier than mortar for brick or concrete masonry. Discard mortar when it has reached initial set.
- C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Pigments shall not exceed 5 percent of masonry cement by weight.
 3. Mix to match Architect's sample.
- D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine sills, jambs, and heads surrounding glass unit masonry assemblies for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING GLASS BLOCK WITH MORTAR

- A. Apply a heavy coat of asphalt emulsion to sill and adhere expansion strips to jambs and heads with asphalt emulsion. Allow asphalt emulsion to dry before placing mortar. Trim expansion strips to width required to fit glass block and to full lengths of heads and jambs.
- B. Set glass block with completely filled bed and head joints, with no furrowing, accurately spaced and coordinated with other construction. Maintain 1/4-inch exposed joint widths unless otherwise indicated.
- C. Install panel reinforcement in horizontal joints at spacing indicated and continuously from end to end of panels; comply with the following requirements:
1. Vertical Spacing of Panel Reinforcement for Exterior Panels: Every other course but not more than 16 inches o.c., starting with first course above sill.
 2. Do not bridge expansion joints with panel reinforcement.

3. Place panel reinforcement in joints immediately above and below all openings within glass unit masonry assemblies.
 4. Lap panel reinforcement not less than 6 inches if more than one length is necessary.
 5. Embed panel reinforcement in mortar bed by placing lower half of mortar bed first, pressing panel reinforcement into place and covering with upper half of mortar bed.
- D. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcement occurs. Extend panel anchors at least 12 inches into joints, and bend within expansion joints at edges of panels and across the head. Attach panel anchors as follows:
1. For new unit masonry assemblies, embed other ends of panel anchors, after bending portions crossing expansion joint, in horizontal mortar joints closest in elevation to joints in glass unit masonry assemblies containing panel anchors.
 2. For steel members, attach panel anchors with 1/4-inch-diameter through bolts and nuts or bolts in tapped holes in steel members.
- E. Use rubber mallet to tap units into position. Do not use steel tools, and do not allow units to come into contact with metal accessories and frames.
- F. Use plastic spacers or temporary wedges in mortar joints to produce uniform joint widths and to prevent mortar from being squeezed out of joints.
1. If temporary wedges are used, remove them after mortar has set and fill voids with mortar.
- G. Keep expansion joints free of mortar.
- H. Rake out joints indicated to be pointed to a uniform depth sufficient to accommodate pointing material, but not less than joint width.
1. If temporary wedges are used, remove them before raking out and pointing joints.
 2. Point joints at exterior face of exterior panels with mortar.
- I. Point joints with mortar by filling raked joints and voids. Place and compact pointing mortar in layers not more than 3/8 inch thick. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
1. Tool exposed joints slightly concave when pointing mortar is thumbprint hard. Use a smooth plastic jointer larger than joint width.
- J. Clean glass unit masonry assemblies as work progresses. Remove mortar fins and smears immediately, using a clean, wet sponge or a scrub brush with stiff fiber bristles. Do not use harsh cleaners, acids, abrasives, steel wool, or wire brushes when removing mortar or cleaning glass unit masonry assemblies.
- K. Install sealant at jambs, heads, mullions and other locations indicated 48 hours after installation of glass block. Prepare joints, including installation of primer and bond-breaker tape or cylindrical sealant backing, and apply elastomeric sealants to comply with requirements in Section 07920 "Joint Sealants."
- L. Construction Tolerances: Set glass block to comply with the following tolerances:
1. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more.

2. Variation from Level: For bed joints, and other conspicuous lines, do not exceed, 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
3. Variation of Location in Plan: For location of elements in plan do not vary from that indicated by more than plus or minus 1/4 inch.
4. Variation in Mortar-Joint Thickness: Do not vary from joint thickness indicated by more than plus or minus 1/16 inch.
5. For faces of adjacent exposed units, do not vary from flush alignment by more than 1/16 inch.

3.3 CLEANING

- A. On surfaces adjacent to glass unit masonry assemblies, remove mortar, sealants, and other residue resulting from glass-block installation, in a manner approved by manufacturers of materials involved.
- B. Remove excess sealants with commercial solvents according to sealant manufacturer's written instructions. Exercise care not to damage sealant in joints.
- C. Perform final cleaning of glass unit masonry assemblies when surface is not exposed to direct sunlight. Start at top of panel using generous amounts of clean water. Remove water with clean, dry, soft cloths; change cloths frequently to eliminate dried mortar particles and aggregate.

****END OF SECTION****

SECTION 05220

CONCRETE BOLTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide concrete anchor bolts, inserts, complete, in accordance with the Contract Documents. Principal items are anchor bolts placed in concrete, adhesive anchors, expansion bolts, and drilled anchors.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections apply to the WORK of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03300 Cast in Place Structural Concrete
 - 3. Section 03315 Grout
 - 4. Section 05500 Miscellaneous Metals
 - 5. Steel supports hangers, brackets and other miscellaneous items accessory to mechanical and electrical installations indicated or detailed on the Contract Drawings, and in Divisions 15 and 16.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- C. Federal Specifications
 - MIL-A-907E Antiseize Thread Compound, High Temperature
- D. Commercial Standards (Current Edition):
 - AWS B2.1 Welding Procedure and Performance Qualifications
 - AWS D1.1 Structural Welding Code – Steel
 - AISC Steel Construction Manual
- E. ASTM Standards in Building Codes (Current Edition):
 - ASTM A36 Carbon Structural Steel

ASTM A123 Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware

ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications

ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

ASTM A307 Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength

ASTM A320 Alloy Steel and Stainless Steel Bolting for Low Temperature Service

ASTM A563 Carbon and Alloy Steel Nuts

ASTM F1554 Anchor Rods, 36, 55, and 105 ksi Yield Strength

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop drawings of all concrete bolts shall be submitted to the CONSTRUCTION MANAGER for review in accordance with Section 01300 - Submittals.
- B. An International Code Council (ICC) report listing the ultimate load capacity in tension and shear for each size and type of adhesive and expansion concrete anchor used shall be submitted for review. The CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for all adhesive and expansion anchors for review and approval. The CONTRACTOR shall follow approved procedures during installation of concrete anchors.
- C. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICC report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Anchor Bolts: Anchor bolts shall be fabricated of materials complying with SSPWC Subsections 206-1.4.1 and 209-2.2, and as follows:
 - 1. Steel bolts ASTM F1554, Grade 36
 - 2. Fabricated steel bolts ASTM A36
 - 3. Stainless steel bolts, nuts, washers ASTM A320, Type 316
- B. Standard Service Bolts (Not Buried or Submerged): Except where otherwise indicated, all bolts, anchor bolts, and nuts shall be steel, galvanized after fabrication as indicated herein. 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, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM F1554, Grade 36, or threaded parts of ASTM A36.

- C. Buried, Outdoor or Submerged Bolts: Unless other corrosion-resistant bolts are indicated, all bolts, anchor bolts, nuts and washers which are buried, outdoor, submerged, or below the top of the wall inside any hydraulic structure shall be Type 316 stainless steel conforming to ASTM A193 for bolts, and to ASTM A194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E.
 - 1. Antiseize lubricant shall be classified as acceptable for potable water use.
 - 2. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131, or approved alternate.
 - D. Bolt Requirements:
 - 1. The bolt and nut material shall be free-cutting steel.
 - 2. 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. All bolts and cap screws shall have hexagon heads, and nuts shall be Heavy Hexagon Series.
 - 3. 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 2-inch beyond the nut.
 - E. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICC report verifying strength and material equivalency.
 - 1. Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Epoxy anchor grout shall comply with Section 03315 - Grout. Threaded rod shall be stainless steel Type 316.
 - F. Expanding-Type Anchors: Expanding-type anchors, if indicated or permitted, shall be steel expansion-type HILTI "KB-TZ" or approved alternate. Lead caulking anchors will not be permitted. Size shall be as indicated. Expansion-type anchors, which are to be embedded in grout, may be steel. Nonembedded buried, or submerged anchors shall be stainless steel.
 - G. Powder-Driven Pins: Powder-driven pins for installation in concrete are not allowed.
- 2.2 GALVANIZING
- A. Iron and Steel. ASTM A123, with average weight per square foot of 2.0 ounces, and not less than 1.8 ounces per square foot.
 - B. Ferrous Metal Hardware Items. ASTM A153 with average coating weight of 1.3 ounces per square foot.
 - C. Touch-up Material for Galvanized Coatings. Repair galvanized coatings marred or damaged during erection or fabrication by use of AMCO 321, as manufactured by the American Solder and Flux Company, Galvalloy, Rust-Oleum Stops Rust Cold Galvanizing Spray, or approved alternate, applied in accordance with the manufacturer's instructions.
- 2.3 WELDING ELECTRODES

- A. Steel Electrodes. Use welding electrodes conforming with AWS D1.1, except E7024 rods or electrodes are not to be used.
- B. Stainless Steel Electrodes. Perform welding of stainless steel with electrodes and techniques as contained in pertinent AWS A5 series specification and as recommended in Welded Austenitic chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Installation: Except as otherwise indicated, the fabrication and installation of anchor bolts shall conform to the requirements of the American Institute of Steel Construction "Steel Construction Manual."
- B. Install adhesive expansion and drilled anchor bolts in accordance with method specified in ICC for manufacturer product.

3.2 WELDING

- A. Perform all welding in accordance with the "Structural Welding Code-Steel", AWS D1.1, and current revisions. Use only welders qualified by tests in accordance with AWS B2.1.

3.3 GALVANIZING

- A. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A123 and ASTM A153. Field repairs to galvanized coatings shall be made as noted above.

3.4 INSPECTION

- A. The OWNER reserves the right to inspect all materials and workmanship covered in this Section. Such inspections will not relieve the CONTRACTOR of its responsibility to furnish materials and workmanship in accordance with the Specifications. If inspections indicate that materials or workmanship are defective, the CONTRACTOR shall remove and replace the defective work at no additional cost to the OWNER.

****END OF SECTION****

SECTION 05500

MISCELLANEOUS METALS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide miscellaneous metals and appurtenances, complete, in accordance with the Contract Documents.
- B. Work Included in this Section. Principal items are:
 - 1. Shop/erection drawings and samples.
 - 2. Metal grating with incidental supports and attachments.
 - 3. Checkered plate.
 - 4. Ladders
 - 5. Iron castings.
 - 6. Steel channels and/or angle frames and thresholds with anchors.
 - 7. Welding electrodes.
 - 8. Shop prime paint.
 - 9. Pipe supports with saddles, hangers, bracing and attachments as detailed and required, except as provided by other trades.
 - 10. Miscellaneous iron and steel items indicated, specified, or required for completion of the Contract, unless included under other Sections.
 - 11. Warning signs.
 - 12. Galvanizing and shop primer finishes, including field touch-up.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03200 Reinforcement Steel
 - 2. Section 03300 Cast-in-Place Structural Concrete
 - 3. Section 03315 Grout
 - 4. Section 05220 Concrete Bolts
 - 5. Section 07720 Roof Accessories

6. Section 09800 Protective Coating
7. Steel supports, hangers, brackets and other miscellaneous items accessory to mechanical and electrical installations indicated on the Drawings, or covered in Divisions 15 and 16.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. Commercial Standards:

- | | | |
|----|---------------|--|
| a. | AASHTO | HS-20 Truck Loading |
| b. | AISC | Steel Construction Manual |
| c. | AISC 303 | Code of Standard Practice for Structural Steel Buildings and Bridges |
| d. | AISC 360 | Specification for Structural Steel Buildings |
| e. | AISI | Design of Light Gauge, Cold-Formed Steel Structural Members |
| f. | AWS | A5 Series |
| g. | AWS-D1.1 | Structural Welding Code - Steel |
| h. | AWS-B2.1 | Welding Procedure and Performance Qualification |
| i. | NFPA 101 | Life Safety Code |
| j. | NAAMM AMP 510 | Metal Stairs Manual |
| k. | AWS-D1.6 | Structural Welding Code – Stainless Steel |

2. ASTM Standards in Building Codes:

- | | | |
|----|----------|---|
| a. | ASTM A6 | General Requirements for Rolled Steel Bars, Plates, Shapes and Sheet Piling |
| b. | ASTM A36 | Carbon Structural Steel |
| c. | ASTM A48 | Gray Iron Castings |

d.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
e.	ASTM A123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
f.	ASTM A125	Steel Springs, Helical, Heat Treated
g.	ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
h.	ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
i.	ASTM A193	Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
j.	ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both
k.	ASTM A276	Stainless Steel Bars and Shapes
l.	ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates
m.	ASTM A307	Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
n.	ASTM A320	Alloy Steel and Stainless Steel Bolting for Low Temperature Service
o.	ASTM A424	Steel, Sheet, for Porcelain Enameling
p.	ASTM A500	Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
q.	ASTM A536	Ductile Iron Casting
r.	ASTM A563	Carbon and Alloy Steel Nuts
s.	ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
t.	ASTM A575	Steel Bars, Carbon, Merchant Quality, M-Grades
u.	ASTM A786	Hot Rolled Carbon, Low Alloy, High Strength Low Alloy, and Alloy Steel Floor Plates
v.	ASTM B98	Copper-Silicon Alloy Rod, Bar, and Shapes
w.	ASTM B438	Bronze Base Powder Metallurgy (PM) Bearings (Oil-Impregnated)

3. Trade Standards:
 - a. Welded Austenitic Chromium-Nickel Stainless Steel Technique and Properties, as Published by the International Nickel Company, Inc., New York, New York.
 - b. Porcelain Enamel Institute, Inc.

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop drawings shall be submitted in accordance with Section 01300 - Submittals.
- B. Layout Drawings: Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.
- C. Product List and Product Data Sheets: In coordination with Section 09800 - Protective Coating, a product list shall be submitted with product data sheets of intended shop coats. Shop coats shall be the same products and manufacturer as those of deferred field-applied systems described in Section 09800 - Protective Coating.

1.5 QUALITY ASSURANCE

- A. Miscellaneous metals shall be fabricated and erected in accordance with the latest edition of the AISC "Specification for Structural Steel Buildings ", and "Code of Standard Practice for Structural Steel Buildings and Bridges ", except whenever there is a discrepancy between the design drawings and this specification, the Drawings shall govern.
- B. Continuous Inspections: All welding and high strength bolting of structural steel assemblies shall be conducted under the continuous inspection of an International Code Council (ICC) certified "Special Inspector" selected by the CONTRACTOR with costs borne by the CONTRACTOR. Should such fabrication be performed in the shop of a licensed fabricator approved by the governing building official and certified by the ICC Evaluation Services, Inc. Only the field welding and high strength bolting of structural steel assemblies will be required to be performed under continuous inspection of the ICC-certified "Special Inspector." The OWNER shall be notified at least 24 hours in advance of needed inspections. Copies of inspection reports for shall be provided for the OWNER, CONTRACTOR, and governing building official.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Steel: Steel shall conform to the following requirements:
 1. Shapes, Plates, Bars ASTM A36 unless otherwise indicated on the Drawings
 2. Pipe, Pipe Columns, Bollards ASTM A53, Type E or S, Grade B Schedule 40, unless noted otherwise
 3. Tubes ASTM A500, Grade B

- B. Stainless Steel: Unless otherwise designated or approved, stainless steel alloy types shall conform to ASTM A167 and ASTM A276 as follows:
 - 1. Stainless steel plates, pipe and structural shapes: Type 316L.
 - 2. Stainless steel bolts, nuts and washers: Type 316L where connecting or bearing on aluminum.
- B. Cast Iron: Cast iron shall conform to ASTM A48, except as otherwise noted.
- C. Ductile Iron: Ductile iron shall conform to ASTM A536, using Grade 60-40-18 or better, except as otherwise noted.

2.2 STEEL PIPE HANDRAILS / GUARDRAILS

- A. Steel Pipe Handrails: Steel pipe handrails, including brackets and related hardware, which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316L stainless steel. All other steel pipe handrail shall be as specified on the Drawings and shall be pickled at fabrication plant and hot-dip galvanized after fabrication.

2.3 METAL GRATING

- A. General: Metal grating shall be of the design, sizes, and types indicated. All grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners. Grating shall conform to the following requirements:
 - 1. All pieces of grating shall be fastened in two locations to each support.
 - 2. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral nonslip nosing, width equal to that of the stairway.
 - 3. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 3 inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated load of 1,000 pounds. For heavy duty grating, the loading used for determining stresses and deflections shall be AASHTO HS-20.
- B. Grating Materials: Grating materials shall conform to the following requirements:
 - 1. Grating which may be partially or wholly submerged shall be fabricated entirely of Type 316 stainless steel. All other grating shall be as specified on the Drawings and shall be hot-dip galvanized after fabrication.
- C. Standard-Duty Grating:
 - 1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.
 - 2. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.

- D. Safety Grating: Safety grating shall be made of sheet metal punched into an open serrated diamond pattern and formed into plank sections. The open diamond shapes shall be approximately 1/2 inch by 11/16 inch in size.
- E. Heavy-Duty Grating: Heavy-duty grating shall be of welded steel, galvanized after fabrication. Cross bars shall be welded in position.
- F. Grating Fastening Devices: For metal gratings, either welded or mechanical attachments shall be used except where otherwise noted for locations such as stair treads and incidental landings.

2.4 CHECKERED PLATE

- A. Checkered Plate: Checkered plate shall conform to Federal Specification QQ-F461. Checkered plate shall be not less than 3/16 inch thick, and shall have a pattern of raised lugs on one face and shall be smooth on the opposite face. Lugs shall be a minimum of one inch in length and raised a minimum of 0.050 inch above the surface. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in two orthogonal directions. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.
- B. Plate material: Where no plate material is indicated, stainless steel shall be provided. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection, resulting from a live load of 100 psf, to 3 inch or the span divided by 240, whichever is less.

2.5 LADDERS

- A. Ladders shall be hot-dip galvanized steel after fabrication.

2.6 IRON CASTINGS

- A. General: Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shotblasting.
- B. Covers and Grates: Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
- C. Design Loads: Covers and grates with matching frames shall be designed to support the following loadings:
 1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no loading is given, a minimum of 300 pounds per square foot, unless indicated otherwise.
 2. Exterior covers and grates shall be designed for AASHTO HS-20 loading unless indicated otherwise.
- D. Cover Details: Unless indicated otherwise, access manway covers shall be two-part street type removable covers. Larger cover shall be for a 48-inch diameter clear opening with 24-inch diameter cover offset from the center as indicated. Raised lettering shall be as indicated.

2.7 GALVANIZING

- D. Galvanizing for Iron and Steel: Galvanizing for iron and steel shall conform to ASTM A123, with the average weight of 2.0 ounces per square foot, and not less than 1.8 ounces per square foot.
- E. Ferrous Metal Hardware Items: Ferrous metal hardware items shall conform to ASTM A153, with average coating weight of 1.3 ounces per square foot.

2.8 WELDING ELECTRODES

- A. Steel Electrodes: Welding electrodes shall conform with AWS D1.1, except E7024 rods or electrodes shall not be used.
- B. Stainless Steel Electrodes: Welding of stainless steel with electrodes and techniques shall conform to the pertinent AWS A5 series specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

2.9 BOLTS

- A. Bolt Requirements: Bolts shall comply with the following:
 - 1. Nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
 - 2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 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 A307, or threaded parts of ASTM A36.
- C. Bolts Buried or Inside Tanks or Channels: Unless otherwise indicated, bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.

2.10 SHOP PRIME PAINT

- A. Shop Prime Paint: To ensure compatibility with deferred field-applied paint or coating systems, for ferrous metals other than stainless steel, galvanized steel and cast iron, provide surface preparations, and use shop prime paint product and manufacturer as painting, or protective coating system intended for field application specified in Section 09800 - Protective Coating. Shop prime shall not be provided on portions of work immediately adjacent to intended field welds, or on portions intended for embedment. Steel stair nosings shall be painted with industrial "Safety Yellow" enamel prime and finish coats conforming with California OSHA requirements.

2.11 MANUFACTURERS

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or approved alternate):
 - 1 Steel Gratings:

- a. Harsco Type IWA
 - b. McNichols
2. Floor and Cover Plates:
- a. Steel Tread Plate
3. Fall Prevention System:
- a. Capital Safety (DBI Sala/3M Company)
 - b. Miller (Honeywell Safety Products)
4. Manhole Frames and Covers:
- a. Neenah Foundry Company R-1642 with Self-Sealing Cover
 - b. Phoenix Iron Works P-1090 R/G
5. Field Repairs to Galvanizing:
- a. "Carbozinc 11 HS"
 - b. "AMCO 321"
 - c. "Galvalloy"

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Steel Construction Manual."
- 1. The Work of this Section shall be coordinated with related trades. Particular attention is required for items to be embedded in concrete work. All punchings and drillings, indicated or required, shall be provided for attachment of other work to that of this Section.
 - 2. Compliance with Safety Requirements. Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangers and etc. which are not shown on the Drawings, shall conform to the Division of Occupational Health and Safety, General Industrial Safety Orders, State of California.
- B. Protection: The CONTRACTOR shall provide and be responsible for protection and repair of adjacent surfaces and areas which may become damaged as a result of work in this Section. Work performed hereunder shall be protected until completion and final acceptance of project by the OWNER. The CONTRACTOR shall repair or replace all damaged or defective work to original specified condition at no additional cost to the OWNER.
- 1. Finished floor surfaces and adjacent work shall be protected from damage. Concrete floors shall not be overloaded. Mobile equipment used in placing steel shall have pneumatic tires. Steel members shall not be placed directly on floors; pads of timber or other material shall be used for cushioning.
 - 2. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

- C. Pipe Rails and Railings: Pipe rails and railing shall be fabricated complete with stanchions, toe plates, welded and bolted fittings, attachments and expansion/contraction provisions true to size configurations to meet or exceed the requirements of CAL/OSHA, and as shown on the Drawings. The CONTRACTOR shall grind and polish welds flush and smooth. Curves, where indicated or necessary, shall be bent on a radius of not less than 5 inches.
1. Safety chains shall be 1/2-inch link chain of same material as the railing with stainless steel harness-type snap to meet or exceed the requirements of CAL/OSHA.
 2. Provisions shall be made to drain water from rail systems by drilling weep holes in concealed locations at the lowest possible elevations.
- D. Ladders: Ladder fabrication shall conform to requirements shown on the drawings and CAL/OSHA (and/or OSHA).
- E. Pipe and Conduit Supports and Bracing: Supports and bracing for pipe and conduit shall be fabricated and installed as detailed on the Drawings, and in accordance with the requirements described in Section 15020 - Pipe Supports, in a fully coordinated manner with the Work of other trades. Where shown or indicated, hot-dip galvanized shall be provided after fabrication, with touch-up of abraded or burned galvanizing using materials specified in this Section. Unless otherwise indicated, members shall be shop primed with a rust-inhibitive primer conforming with requirements of Section 09800 - Protective Coating.
- F.. Embedded Steel Channel and Angle Frames: Embedded steel channel and angle frames shall have continuously welded joints. Exposed welds shall be ground flush. Hot-dip galvanizing shall be provided after fabrication.
- G.. Warning Signs: Warning signs shall be furnished and installed in the locations specified below. Provide signs that are not less than designated sizes. Fabricate signs of porcelain enamel safety blanks with red lettering on a white background. Fabricate using 18 ga vitreous enameling steel (ASTM A424 - type II). Equip each with 6 eyeleted holes for No. 10 fastener. Provide fused porcelain enamel, both sides, suitable for exterior or industrial end use by experienced fabricators in strict conformance with pertinent requirements as published by Porcelain Enamel Institute, Inc.
1. Attach a 7-inch by 10-inch sign to each hose bib that reads:

"DO NOT DRINK"
"NO TOMAR AGUA"
 3. 2. Provide and post near all automatic machinery, a 10 inch by 14 inch sign that reads:

"CAUTION: AUTOMATIC MACHINERY MAY START AT ANY TIME"
"PRECAUCION: MAQUINARIA PUEDE EMPEZAR EN CUALQUIER MOMENTO"
 3. Provide and attach to the interior side of all access doors which provide egress to the outside a 7 inch by 10 inch sign that reads:

"EXIT"
"SALIDA"

Where shown on the Drawings, provide illuminated exit signs.

3.2 WELDING

- A. Welding Steel: Welding shall be performed in accordance with the "Structural Welding Code-Steel", AWS-D1.1, and current revisions, except where the Gas Metal Arc Welding (GMAW)

process is used, the short-circuited mode shall only be used for light gauge material (12 gauge and lighter). Welders shall be qualified by tests in accordance with AWS-B2.1.

3.3 GALVANIZING

- A. Galvanizing: All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A153. Field repairs to galvanizing shall be made using "Galvalloy," "AMCO 321," or approved alternate.

3.4 PAINTING

- A. Painting: One or more shop coats of paint shall be given on all ferrous metals, except cast-iron, ductile iron, stainless steel and galvanized metals. Before priming, surfaces shall be thoroughly cleaned. Shop coats shall be allowed to dry before materials are loaded for delivery to the job site. After erection, all areas shall be painted where the shop coats have been rubbed off or omitted, and all field bolting and welding areas as specified for shop priming. See Section 09800 - Protective Coating for surface preparation, prime coatings, finish painting and coatings.
- B. Isolation of Dissimilar Metals: Aluminum members shall be isolated from contact with dissimilar metals, concrete and masonry to provide protection from electrolytic deterioration. The CONTRACTOR shall use nonabsorptive tape or gaskets, a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, or a heavy coat of approved alkali-resistant bituminous paint.

****END OF SECTION****

SECTION 07100

WATERPROOFING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTACTOR shall provide waterproofing and moistureproofing of concrete and reinforced concrete block masonry surfaces.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM D 41 Specification for Asphalt Primer Used in Roofing and Waterproofing
 - 2. ASTM D 226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - 3. ASTM D 312 Specification for Asphalt Used in Roofing

1.4 SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Manufacturer's product data including catalogue cuts.
 - 2. Manufacturer's installation instructions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Only products certified as complying with the indicated requirements shall be provided.
 - B. Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
 - C. Products shall be recommended by the manufacturer for the application indicated.
- 2.2 WATERPROOFING COATING
- A. Waterproofing coating shall be a coal tar epoxy resin.
- 2.3 MOISTUREPROOFING COATING
- A. Moistureproofing coating shall be a coal tar solution.
- 2.4 WATERPROOFING MEMBRANE
- A. Waterproofing membrane shall be minimum 60-inchwide sheets of bituminous and synthetic resins reinforced with an inert material for puncture resistance of at least 200 pounds. Thickness of the sheet shall be 60 mils, minimum.
- 2.5 WATERPROOFING PROTECTIVE BOARD
- A. Protective board shall be 1-inch asphalt impregnated insulation board.
- 2.6 MOISTUREPROOFING UNDERLAY
- A. Plastic membrane for moistureproofing underlay shall be polyethylene film with a thickness of 10 mils.
- 2.7 MOISTUREPROOFING UNDERLAY TAPE
- A. Pressure sensitive tape shall be 2-inch wide polyethylene tape.
- 2.8 BELOW-GRADE WATERPROOFING
- A. Waterproofing materials for use below grade shall conform to the following:
 - 1. Below-grade waterproofing shall be cold-applied waterproofing system for concrete block masonry or concrete walls. It shall consist of a primer coat covered with not less than 3 coats of fibrated asphalt emulsion, and not less than one layer of 15 pound asphalt thick bituminous-impregnated protective fiberboard for membrane protection during backfill. The waterproofing system shall be designed to withstand a 1-foot hydrostatic head.
 - 2. Expansion joint sheets shall be tough, pliable, waterproof sheets of high quality polyethylene coated on one side with a thick, factory-applied layer of adhesive-consistency rubberized asphalt.
- 2.9 MANUFACTURERS
- A. Products shall be of the type and manufacture as indicated below (or equal):
 - 1. Waterproofing Coating:
 - a. Carboline Bitumastic 300-M
 - b. or approved alternate

2. Moistureproofing Coating:
 - a. Carboline Bitumastic 50
 - b. or approved alternate

3. Waterproofing Membrane:
 - a. W.R. Grace and Company's "Bituthene"
 - b. Protecto Wrap Co.'s "Jiffy Seal"
 - c. or approved alternate

4. Waterproofing Protective Board:
 - a. Celotex (Saint-Gobain) Insulation Board
 - b. or approved alternate

5. Below-Grade Waterproofing:
 - a. Waterproofing System:
 1. EMW-1 Waterproofing System by Shell Flintkote Company
 2. or approved alternate

 - b. Expansion Joint Sheets:
 1. "Flash-bend" by Shell Flintkote Company
 2. "Bituthene" by W.R. Grace and Co.
 3. or approved alternate

 - c. Emulsion:
 1. Liquid Boot, LBI Technologies, Inc.
 2. Sealmastic Emulsion, W.R. Meadows
 3. or approved alternate

 - d. Geotextiles: Carlisle 300 HV Protection Course
 1. or approved alternate

PART 3 - EXECUTION

3.1 GENERAL

- A. Products shall be installed in accordance with the manufacturer's installation instructions.

3.2 WATERPROOFING COATING

- A. Location: Waterproofing coating shall be applied to the water side of walls and bottoms of channels or tanks which are common with rooms, tunnels or galleries to be occupied by equipment, piping, conduit, or personnel.

- B. Surface Preparation: New concrete to be waterproofed shall have aged at least 28 days and allowed to dry to a moisture content recommended by the coating manufacturer. Concrete surfaces shall be sandblasted. Voids and cracks shall be repaired.

- C. Applications: Prime coat shall be thinned and applied at the rate of approximately 200 to 300 square feet per gallon depending on surface condition. Finish coats shall be applied at the rate of 100 square feet per gallon. Final coat shall be black. Total dry film thickness shall be minimum 20 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.3 MOISTUREPROOFING COATING

- A. Moistureproofing coating shall be applied to exterior of outside concrete walls which are below grade and are common with rooms, tunnels or galleries to be occupied by equipment, piping or personnel, unless a "below-grade waterproofing" system is indicated.
- B. Surface Preparation: Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scrapping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with sealer or block filler compatible with the indicated primer.
- C. Application: Each prime and finish coat shall be applied at the rate of 70 square feet per gallon. The number of finish coats shall be sufficient to produce a dry film thickness of at least 15 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.4 WATERPROOFING MEMBRANE

- A. Location: Waterproofing membrane shall be applied to surfaces indicated.
- B. Surface Preparation: Concrete surfaces shall be clean, dry and free of voids, spalled areas, loose aggregate, and sharp protrusions, with no coarse aggregate visible.
- C. Application: Waterproofing membrane shall be applied in accordance with the manufacturer's recommendations. Surfaces shall be clean and primed before application of the membrane.

Pipes or conduits entering structures shall be watertight. The protective board shall be placed directly against membrane before backfilling. Where the membrane is turned up from the base of the walls, at angles in walls, and at any other place where the membrane may be subjected to unusual strain, strips, consisting of two additional plies of membrane shall be applied.

3.5 MOISTUREPROOFING UNDERLAY

- A. Location: Unless otherwise indicated, moistureproofing underlay shall be provided under all concrete slabs-on-grade.
- B. Surface Preparation: Backfilled surfaces to receive moistureproofing underlay shall be leveled off and smoothed over to minimize contact with sharp edges.
- C. Application: At joints, moistureproofing membrane shall be lapped 6 inches and sealed with pressure sensitive tape. Where pipes and conduits pass through the membrane, they shall be wrapped tightly with separate sheets of membrane which shall then be sealed with tape to the main membrane. Reinforcing steel or wire mesh shall be supported to protect the membrane.

3.6 BELOW-GRADE WATERPROOFING

- A. All buried planters and exterior of concrete walls, where indicated, shall be protected from moisture with below-grade waterproofing system.

****END OF SECTION****

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SECTION 07600

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all sheet metal work and appurtenant work, complete, in accordance with the Contract Documents.
- B. The principal items of sheet metal work include sheet metal flashings, collars, pitch pockets (pans), equipment platforms, and equipment (sleeper) supports at all roof penetrations. Also included are gutters and downspouts and precast concrete splash blocks for use with roof downspouts.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07920 Sealants and Caulking
 - 2. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego.
 - 1. California Building Code.
 - 2. California Mechanical Code.
 - 3. California Plumbing Code.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. Federal Specifications
 - A-A-51145C Flux, Soldering, Paste and Liquid
 - MIL-P-24441/20 Primer Coating, Zinc Dust-Zinc Oxide (For Galvanized Surfaces)
 - UU-B-790A REINST2 Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent and Fire Resistant)
 - 2. ASTM Standards in Building Codes:
 - ASTM A 176 Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
 - ASTM A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 32	Specification for Solder Metal
ASTM B 209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D 1187	Test Method for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 2822	Specification for Asphalt Roof Cement

3. Trade Standards:

Sheet Metal and Air Conditioning DESIGN/BUILDERS National Association "Architectural Sheet Metal Manual" (SMACNA) fifth edition, 1993.

The Aluminum Association "Specifications for Aluminum Sheet Metal Work in Building Construction."

AWS

American Welding Society

1.4 SUBMITTALS

- A. General: The following shall be submitted to the CONSTRUCTION MANAGER for review, approval, or verification in accordance with Section 01300 - Submittals.
- B. Samples: Color samples and samples shall be submitted where required for color selections and/or review by the CONSTRUCTION MANAGER.
- C. Shop Drawings: Shop drawings showing materials, gauges, finishes, layout, jointing, profiles, fasteners, fabrication of special shapes, and method of attachment to adjacent construction shall be submitted to CONSTRUCTION MANAGER.
- D. Manufacturers Information: Manufacturers literature indicating materials, finish, construction, and method of installation of prefabricated items and sealants.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Sheet metal shall be aluminum or galvanized steel unless otherwise indicated. Sheet metal work in connection with roofing shall be in accordance with roofing manufacturer's published specifications.
- B. All sheet metal flashings necessary to make building weathertight shall be provided, whether or not specifically indicated.

2.2 ALUMINUM PRODUCTS

- A. Aluminum shall be 0.032-inch minimum thickness and shall conform to ASTM B 209, alloy 3003-H 14, with dark bronze anodized finish AA-C12-A42. Thickness of aluminum to be welded shall be as necessary for welding method being used per AWS.
- B. Reglets shall be of aluminum such as manufactured by Superior Concrete Accessories; Morrison and Company "Cushion-Lock"; Fry Reglet; or equal.

2.3 FERROUS METALS

- A. Galvanized steel shall be 24-gauge minimum thickness conforming to ASTM A 653.

- B. Stainless steel shall be 24-gauge minimum thickness conforming to ASTM A 176, Type 304, dull No. 2D finish.

2.4 LEAD AND SOLDERING MATERIALS

- A. Lead shall be 4 to 6 percent antimony and remainder shall be lead. Lead sheet shall be soft temper, except hard temper for flanges. Weight shall be not less than 4 pounds per square foot unless otherwise shown.
- B. Solder shall conform to ASTM B 32 Alloy 5b, 50 percent tin, 50 percent lead.
- C. Soldering flux shall meet Federal Specification A-A-51145C, of a type not injurious to metal surface being treated.

2.5 FASTENERS

- A. Fastening devices shall be of the same material as the sheet metal being used or corrosion-resistant metal compatible with sheet metal being used. Fasteners exposed to the weather shall have neoprene washers. Washers shall be 0.04-inch minimum thickness. A rubber-type washer shall be used beneath the aluminum washer or fastener head where weathertightness is required.

2.6 PLASTIC CEMENT

- A. Plastic cement shall conform to ASTM D 2822.

2.7 SEALANT MATERIALS

- A. Sealants shall be as specified under Section 07920 - Sealants and Calking or shall be of the silicone type. Colors will be selected by the CONSTRUCTION MANAGER from manufacturers standard colors.
- B. Sealer tape shall be polyisobutylene sealer tape specifically formulated for setting flanges on bituminous roofing, as manufactured by Morrison and Company CL-50; or approved equal.

2.8 COATING MATERIALS

- A. Primer coat for galvanized steel shall conform to Federal Specification MIL-P-24441/20 Type II.
- B. Asphaltic coating compound shall conform to ASTM D 1187.

2.9 BUILDING PAPER OR FELT

- A. Building paper shall conform to Federal Specification UU-B-790A REINST2 Class B for Kraft waterproof building paper and CBC Standard Specifications, with Revisions dated October 28, 1975, of Underwriters Laboratories, Inc. for asphalt or coal tar-saturated felt.

2.10 SHOP FABRICATION REQUIREMENTS

- A. Gutters shall be of size 16 –gauge galvanized steel, with wire basket type strainers of 14-gauge stainless steel wire. Gutters shall be constructed similar to SMACNA Figure 1-17.
- B. Downspouts shall be fabricated from Schedule 40 galvanized steel pipe. Telescope end joints 1-1/2 inches and lock longitudinal joints. Hold downspouts in position as indicated on drawings and securely fasten to the wall with expansion anchors, unless otherwise indicated.

- C. All aluminum shall be welded where indicated.
- D. Galvanized steel corner joints shall be soldered. Other joints shall be as indicated or as required by paragraph 1.3 of this Section.
- E. All Work and finishes shall be protected from scratches and abrasions.
- F. All flashings, reglets and counter-flashing and associated flashings shall be fabricated by the same manufacturer and be installed as a complete flashing system. All flashings shall be creased longitudinally or otherwise formed with sufficient spring action to hold bottom edges firmly against base flashing or similar material.
- G. Flashing required through concrete or clay tile shall be flexible flashing in order to assure against undue separation between tiles on account of rigidity of the flashing material. Flashing around pipes, vents, flues, and chimneys shall be of lead, copper, or other approved flexible flashing material.

2.11 FABRICATED SHEET METAL WORK

- A. Stamped sheet metal vents or louver-type vents (where indicated) shall be designed to provide watertight flush corners and shall be of size indicated. Each vent shall be equipped with 1/4-inch square aluminum mesh hardware cloth insect screen. Stamped metal items shall be made of coated aluminum sheet metal.
- B. Fixed wall louvers shall be extruded aluminum louvers conforming to SMACNA Figure 7-5, unless otherwise indicated. Operable wall louvers shall be designed as indicated and conform to SMACNA Figure 7-3. Louvers and screens shall have dark bronze anodized finish. All exterior louvers shall be provided with 1/8-inch by 1/8-inch mesh bird screen and frame. Screen units shall be removable.
- C. Pitch pockets and equipment supports shall be provided where required or necessary and may be of galvanized steel construction unless otherwise indicated.
- D. The roof penetrations sheet metal work items shall be provided and shall be coordinated with the roofing system. The design and details shall conform to the Reference Standards unless otherwise indicated.
- E. The roof penetrations shall be provided with the following flashing:
 1. Vent pipes: Lead collars vent pipe flashing with top of lead sleeve flashing bent into vent pipe. Ref. SMACNA, Figure 4-14B.
 2. Single pipes: Sheet metal or lead collars with sheet metal or lead draw band with sealant or cap top. Ref. SMACNA, Figure 4-14A or 4-14B.
 3. Multi-pipes: Lead collar with cap. Ref. Stoneman Engineering and Mfg. Co.
 4. Multi-pipes w/curb: Sheet metal with sealant and draw bands. Ref. SMACNA, Figure 4-13.
 5. Equipment support: Sheet metal. Ref. SMACNA, Figure 4-16.
 6. Pitch pockets for supports: Sheet metal with all joints welded or soldered. Ref. SMACNA, Figure 4-16E.

Note (1): Prefabricated products, curbs, supports, and platforms which are part of mechanical equipment may be indicated in other Sections of these Specifications.

2.12 PRECAST CONCRETE SPLASH BLOCKS

- A Provide precast concrete splash blocks as manufactured by Modern Precast, Inc., Salt Lake City, Utah, or approved equal. Size shall be as indicated, or if not indicated 12 inches wide by 30 inches long. Color shall be as selected by CONSTRUCTION MANAGER from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the flashings necessary with the different trades to make sure all items which penetrate the roof are provided with all necessary sheet metal items and work, such as: pipes, ducts, support racks, and equipment supports. Sheet metal shop manufactured curbs, equipment supports, and equipment platforms shall be provided where prefabricated items are not indicated in other Sections of these Specifications.
- B. Flashing work shall be coordinated with roofing work. Sheet metal and roofing shall provide a weathertight and watertight assembly.
- C. Sheet metal work shall be accurately formed to dimensions and shapes indicated. Work shall be fitted snugly, with straight, true lines with exposed faces aligned in proper plane, free from waves and buckles. Arises and angles shall have true and sharp lines, and surfaces shall be free from waves and buckles. All exposed edges shall be hemmed. Holes for fasteners within sheet metal work exposed to temperature changes shall be elongated holes for material expansion and movement.
- D. All sheet metal work shall be furnished complete with supports, hangers, bracing, anchors, and other devices as required for reinforcement and proper attachment to adjacent construction. Fastenings shall be concealed wherever possible. Joints, fastenings, reinforcements, and supports shall be sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
- E. All surfaces upon which sheet metal is to be placed shall be dry, smooth, even, and free of small projections and hollows. Sheet metal shall be laid with all joints true and even and firmly attached with all fastener heads flush with the top surface.
- F. The underlayment shall be overlapped at least 2 inches so as to shed water and shall be secured along the lapped edges. Aluminum fasteners shall be used with aluminum sheet metal.
- G. Dissimilar materials shall be isolated with two coats of asphaltic paint, asphaltic coating compound, or sealer tape. Only stainless steel fasteners shall be used to connect isolated dissimilar metals.
- H. Joints shall be sized and spaced to permit sheet movement for thermal expansion and contraction of 1/4 inch per 10-foot length, on 100 degree F temperature difference. Holes for fasteners or anchors shall be elongated to provide for movement.
- I. Roofing sheet metal items shall be built into the roofing in strict accordance with directions of roofing manufacturer.

3.2 INSTALLATION

- A. Gutters shall have baffle-type expansion joint with expansion cap over 1-1/2-inch baffle flange at 40-foot centers. A 1-inch gap between the baffles shall be allowed.
- B. Flashings at vertical surfaces shall be installed at intersections of roof with vertical surfaces and at projections through roof. Corner units shall be factory-fabricated and shall have mitered soldered or welded corner joints, and shall be installed with 3-inch (min) lap joint over flashings on each side.
- C. Gutters shall be provided to indicated cross-section, complete with shop-fabricated corners, nipple sections, joining plates, concealed hangers and downspouts with standoff brackets.
- D. Flanges of sheet metal items shall be set on continuous sealer tape on top edge envelope ply of roofing. Flanges shall be nailed through sealer tape at 3-inch (max) spacing or securely fastened per Reference Standards.

****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, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07600 Flashing and Sheet Metal
 - 2. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:
 - 1. Uniform Building Code (UBC)
 - 2. Uniform Fire Code (UFC)
 - 3. National Electrical Code (NEC)
- C. Except as otherwise indicated, the current edition of the National Roofing Contractors Association (NRCA) trade standard shall apply to the Work of this Section.

1.4 SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Manufacturer's specifications, literature, and published installation instructions for each roof accessory, product, or system.
 - 2. Shop drawings for each product showing materials, gauges, sizes, finishes, profiles, fabrication of special shapes, fasteners, and method of attachment to adjacent construction shall be submitted.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored on wood blocking in an area that is protected from all deleterious elements. Storage shall be in a manner that will prevent damage or marring of the products and their finishes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Roof accessories shall be in accordance with the manufacturer's literature and published specifications for the products indicated.
- B. Sizes of openings indicated are minimum allowable.
- C. Hatches, fire hatches, and openable fire and smoke hatch with skylights shall be provided complete with all necessary hardware. Hatch hardware shall be stainless steel products. Hardware for hatches shall include the following: inside-outside handles and latching hardware which is padlockable from side, hinges, compression struts, and neoprene gaskets for weatherstripping.
- D. Roof hatches and openable fire and smoke hatches with skylights shall be insulation lined and weatherstripped metal covered designed hatch units with insulated metal integral flange curb (12-inch minimum height).

2.2 ROOF VENTS

- A. Roof relief vents with bird screens shall be provided, and shall be of the type recommended by the National Roofing Association and approved by the roofing manufacturer.

2.3 MANUFACTURERS

- A. Products shall be of the following manufacturer and type or model (or approved equal):
 - 1. Roof Hatches:
 - a. Single leaf: Acudor Products, Inc. AW-APS Angle Frame Floodtight/Gastight Floor Door; 48" x 48" (custom size) or equal by Bilco, Milcor, or Babcock Davis

PART 3 - EXECUTION

3.1 GENERAL

- A. The installation shall conform to applicable codes and the manufacturer's published or written recommendations, specifications, and installation instructions for the type of work being performed.
- B. All roof openings, roof-mounted equipment, duct openings and skylights shall be provided with a prefabricated curb unless the equipment above the roof opening is supplied with its own curb which extends to 8 inches or higher beyond the top of the roof insulation.

3.2 INSTALLATION

- A. Roof hatches, openable fire and smoke hatches, and roof ventilators shall be installed over prepared openings with their own curb or a prefabricated curbs, and shall be fastened to the roof deck in accordance with the manufacturer's printed directions. Lifting mechanisms and accessories shall be adjusted to insure proper operation. Abraded prime and finish coat surfaces shall be touched-up after completion of installation with the same type of finish and the same dry-film thickness. Primer coats of hatches and ventilators exposed to view after

- installation shall be primed with a primer coat that is compatible with the finish coating system.
- B. Roof Hatches: Dissimilar metals shall be properly isolated. Thermal movement for up to 100 degrees F change shall be accommodated without distress in assembly of fasteners.
 - C. Roof Vents: Roof vents shall be provided on lightweight concrete or lightweight insulating concrete and shall be placed in such a manner so that one vent will be used for venting 1,000 square feet of roof fill. No area shall have fewer than 2 vents. Vents shall not be installed in walk pads or other traffic areas. Vent pipes shall have a coat of plastic cement applied at the joint between the vent pipe and the roofing before aggregate is applied. Roof insulation shall be removed from below each vent per NRCA instructions. Roof vents shall be painted to match roofing color.
 - D. Roof accessory metal items exposed to the exterior atmosphere shall be painted with a protective coating complying with Section 09800 - Protective Coating.

****END OF SECTION****

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SECTION 07920

SEALANTS AND CAULKING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide caulking, sealing, moisture protection, and appurtenant Work for sealing joints in non-water bearing surfaces, complete and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

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

- 1. Section 03290 Joints in Concrete Structures

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 City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code as adopted by the City of San Diego Municipal Code.
- C. Except as otherwise indicated, the current editions of the following apply to the work of this Section:

- 1. Federal Specifications:

TT-S-001543A	Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
A-A-1556	Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing, and Glazing in Buildings and Other Structures).
TT-S-00227E (3)	Sealing Compound, Elastomeric Type, Multi-Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
SS-S-200E (2)	Sealant, Joint, Two Component, Cold Applied, for Portland Cement Pavement

- 2. ASTM Standards in Building Codes:

ASTM C 557	Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
ASTM C 834	Specification for Latex Sealing Compounds.
ASTM C 919	Practice for Use of Sealants in Acoustical Applications.
ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM D 41	Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

ASTM D 226	Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D 312	Specification for Asphalt Used in Roofing.
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

- D. **Manufacturer's Standards:** In addition to the standards listed above, the sealants and caulking products and their application shall be in accordance with the manufacturer's published recommendations and specifications.

1.4 SUBMITTALS

- A. The CONTRACTOR shall provide submittals in accordance with Section 01300 - Submittals.
- B. **Samples:** The CONTRACTOR shall submit samples (including color samples) of all the caulking and sealant materials and other moisture protection materials proposed for use on the Work. The samples shall be clearly marked with the manufacturer's name and product identification.
- C. **Technical Data:** The CONTRACTOR shall submit a complete materials list along with the manufacturer's technical data and literature, specifications, joint width and depth tables, and installation instructions.
- D. **Certificates:** The CONTRACTOR shall submit, if requested by the CONSTRUCTION MANAGER, certificates from an independent testing laboratory approved by the CONSTRUCTION MANAGER, certifying that the submitted materials meet all the requirements of the ASTM and Federal Specifications cited.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken.
- B. **Shelf Life:** Materials whose shelf life dates have expired shall not be used in the Work. Such materials shall be promptly removed from the project site.
- C. **Storage:** All materials shall be carefully stored in accordance with the manufacturer's instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the product.

PART 2 - PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

- A. Caulking and sealing materials shall conform to the following requirements:
1. Significant Movement Sealants (\pm 25% movement capability):
 - a. Expansion wall joints; masonry; perimeter sealing (windows, doors); control joints; interior and nontraffic horizontal joints:

- (3) One component, nonsag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-001543A, Class A, and ASTM C 920; Type S; Class 25; Grade NS.
 - a) Products Research & Chemical Corp. APRC-4000".
 - b) Dow Corning A795"; or approved equal.
 - b. Horizontal joints exposed to fuel spillage:
 - (1) Two component, self-leveling, fuel resistant, polyurethane or polysulfide sealant conforming to Federal Specification SS-S-200E(2), Type H, and ASTM C 920; Type M; Class 25; Grade P.
 - a) Products Research & Chemical Corp. "3105-S".
 - b) Pacific Polymers Inc. "ElastoThane 200"; or approved equal.
 - c. Horizontal joints not exposed to fuel spillage:
 - (2) One component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification A-A-1556, Class A, Type I, and ASTM C 920; Type S; Class 25; Grade P.
 - a) Products Research & Chemical Corp. "6006".
 - b) Mameco "Vulkem 45"; or approved equal.
- 2. Glazing Sealants:
 - a. Nonstructural Applications:
 - (1) One component, nonsag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920; Type S; Class 25; Grade NS.
 - a) Products Research & Chemical Corp. "4000".
 - b) Dow Corning "795"; or approved equal.
- 3. Interior Sealant and Caulking:
 - a. General Applications:
 - (1) One component, acrylic latex caulking conforming to ASTM C 834.
 - a) Pecora Corp. "AC-20".
 - b) Bostic "Chem-Calk 600"; or approved equal.
 - b. Nonexposed Acoustical Applications:
 - (1) One component, nondrying, nonhardening, nonshrinking, acoustical caulking conforming to ASTM C 919 as manufactured by:
 - a) Inmont Company "Prestite 579.64".
 - b) Tremco Acoustical Sealant.
 - c) United States Gypsum, "Acoustical Sealant".
 - d) W.W. Henry Type 313 Acoustical Sealant.
- 4. Caulking tapes shall be of the butyl-base, vulcanized type.

5. Filler material shall be resilient, closed-cell polyethylene foam conforming to ASTM D 1752, Type II or III, and/or bond breakers of proper size for joint widths. Filler shall be compatible with sealant manufacturer's product and shall not stain the sealant or the materials to which they are applied.
6. Primer shall be used in accordance with manufacturer's instructions, with all primers being applied prior to the installation of any backer rod or bond breaker tape. Primers shall be as recommended in the manufacturers printed instructions for caulking and sealants and shall not stain the sealant nor the materials to which they are applied. Manufacturer shall be consulted for all surfaces not specifically covered in submittal application instructions.
7. Cleaning and cleanup solvents shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. **Manufacturer's Recommendations:** All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are indicated herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.
- B. **Authorized Installers:** Caulking, sealants, and moisture protection shall be complete systems, and installed only by installers authorized and approved by the respective material manufacturers.

3.2 SEALANT FILLED JOINTS

- A. **Manufacturer's Representative:** The CONTRACTOR shall furnish the onsite services of the sealant manufacturer's representative (before starting sealant work) for inspection of the joints to be sealed and for instructing the installer in the proper use of the materials.
- B. **Surface Preparation:** Joints and spaces to be sealed shall be clean, dry, and free of dust, loose mortar, and other foreign materials. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
- C. **Sealant Depth:** Sealant depth in joints shall be 2 the width of joint, but not less than 1/8 inch deep and 1/4 inch wide nor more than 2 inch deep and 1 inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- D. **Joints In Porous Materials:** Where required by the manufacturer, sides of joints of porous *materials shall be primed immediately prior to caulking or sealing.
- E. **Applications:** A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the

top. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless otherwise indicated.

- F. Cleaning: After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

3.3 ACOUSTIC CAULKING

- A. Preparation: Joints and surfaces to be sealed shall be clean, dry, and free of loose materials.
- B. Concealed Joints: Concealed joints in acoustic partitions including perimeters and intersections of walls and penetrations through finish work and at conduit ends with boxes shall be sealed with acoustic caulking compound. Backs of electrical boxes shall be sealed with acoustic sheet caulking, covering all holes and knockouts.

****END OF SECTION****

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 -- GENERAL

1.1_ WORK OF THIS SECTION

- A. The WORK of this Section includes providing steel doors, frames, and appurtenances.

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 04232 Reinforced Concrete Block Masonry
- 2. Section 08710 Finish Hardware
- 3. 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. 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 A 366 Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
- 2. ASTM B 117 Method of Salt Spray (Fog) Testing
- 3. ASTM D 1735 Method for Water Fog Testing of Organic Coatings
- 4. ASTM E 90 Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions
- 5. ANSI A115 Series Door and Frame Preparation
- 6. UL Standards Underwriters' Laboratories, Inc.

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:

- 1. Manufacturer's product data including catalogue cuts.
- 2. Manufacturer's maintenance procedures.
- 3. Manufacturer's installation instructions.
- 4. Certification that products comply with the specifications indicated.
- 5. Door schedules showing sizes, types, louvers, and glass.
- 6. Certified Sound Transmission Coefficients.
- 7. Shop drawings showing frame jamb depths, trim profile, stops, and backbends.

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.

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 Recommendation: Products shall be recommended by the manufacturer for the application indicated.

2.2 MATERIALS AND FABRICATION

- A. Factory Fabrication: Steel doors and frames shall be factory fabricated and assembled. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and erection shall be included. After fabrication, tool marks and other surface imperfections shall be filled and ground smooth.
- B. Fire Rating and Labeling: Fire-rated doors and frames shall bear a UL label indicating the type of rating. Design and construction of fabricated products shall have UL approval for the fire rating indicated. Hollow steel doors and frames for fire-rated openings shall conform to Underwriters' Laboratories listing and shall be UL labeled.
- C. Materials for Doors and Frames: Exterior doors and frames shall be fabricated of galvanized steel. Other doors and frames shall be fabricated from commercial grade, cold-rolled steel conforming to ASTM A 366, Type II or III.
- D. Priming and Painting: Doors and frames shall be chemically treated to ensure maximum paint adhesion and exposed surfaces shall be painted with a rust-inhibitive primer after fabrication. Prime coat shall be capable of passing a 120-hour salt spray test in accordance with ASTM B 117 and a 250-hour humidity test in accordance with ASTM D 1735.
- E. Hardware: Doors and frames shall be reinforced and drilled or tapped for templated mortised hardware and shall be reinforced with plates for surface-mounted hardware complying with ANSI A115 Series requirements. Hardware shall comply with Section 08710.

2.3 METAL FRAMES

- A. Pressed Metal Frames: Pressed steel frames for doors, windows, and other openings shall be combination buckled frame and trim of type and sizes indicated. Metal shall not be lighter than 16-gauge steel. Frames shall be of the welded unit type. Special frames, oversized frames, and frames with transom shall be provided where indicated.
- B. Frame Jamb Depths, Trim Profile, Stops, and Backbends: Frame jamb depths, trim profile, stops, and backbends shall be as shown on the shop drawings.

2.4 FRAME ANCHORS

- A. Floor Anchors: Floor anchors shall be welded inside each frame jamb head, and holes shall be provided for floor anchorage. Minimum thickness of floor anchors shall be 14-gauge.
- B. Anchors for Masonry/Concrete Installations: Frames for installation in masonry and concrete walls shall include adjustable jamb anchors of the T-strap, stirrups and strap, or wire type. The number of anchors provided for each frame jamb and head shall comply with the applicable standard and the following:
 - 1. Frames up to 7 feet 6 inches in height: 3 anchors.
 - 2. Frames over 7 feet 6 inches to 8 feet 0 inches in height: 4 anchors.
 - 3. Frames over 8 feet 0 inches in height: One anchor for each 2 feet or fraction in height.

2.5 DUST COVER BOXES AND MORTAR GUARDS

- A. Dust cover boxes or mortar guards of not less than 24-gauge steel shall be provided at all hardware mortises on frames to be set in masonry, concrete, or plaster walls.

2.6 SILENCER HOLES

- A. Appropriate holes for silencers shall be provided in the door frames which are not designated to receive weatherstripping, seals, or sound seals.

2.7 STEEL DOORS

- A. Design and Construction: Steel doors shall be of hollow metal construction and shall be of full flush design with no visible seams. Face sheets shall be not less than cold-rolled, stretcher-leveled, galvanized, 14-gauge steel. Doors shall have flush seamless face sheets with continuously and fully welded seam edges. Doors shall be rigid and neat in appearance, and shall be free from warpage or buckle. Corner bends shall be true and straight and shall be of not less than the minimum radius for the gauge of metal used. The door top and bottom shall be internally reinforced by steel members welded in place. Tops of exterior doors shall be provided with flush, water and weather tight, top enclosures.
- B. Transom Panels: Transom panels shall be provided where indicated and shall comply with the requirements for doors.
- C. Door and Transom Cores: Doors and transom cores shall be water-resistant polystyrene. Fire rated doors shall be solid or fiber mineral core doors and shall comply with code requirements.

2.9 MANUFACTURERS

- A. Products shall be manufactured by one of the following (or equal):
 - 1. Steel doors:
 - Krieger Specialty Products Co.
 - Overly Door Co.
 - Trussbuilt, LLC.
 - Hollow Metal Xpress

PART 3 -- EXECUTION

3.1 GENERAL

- A. General: Products shall be installed in accordance with the manufacturer's installation instructions.

3.2 FRAME INSTALLATION

- A. Frames shall be set plumb and square in a true plane, and shall be securely anchored to the adjoining construction. Steel shims shall be provided and shall be tight and rigidly attached between frame anchors and structure. Finished metal frames shall be strong and rigid, neat in appearance, and square, true, and free of defects, warpage, or buckling.
- B. Molded members, trims, and stops, shall be clean cut, straight, and shall be of a uniform profile throughout their lengths.
- C. Corner joints shall have all contact edges tightly closed with all trim faces mitered, welded, and finished smooth. The use of gussets shall not be permitted.

3.3 DOOR INSTALLATION

- A. Doors shall be installed plumb, square, and level. Doors shall operate freely, but not loosely. They shall be free from rattling while in a closed position.
- B. The door clearances shall be plus 3/32-inch or minus 1/32-inch and shall not exceed the limits recommended by the manufacturer.
- C. Doors shall not be installed with an out-of-plane warpage of more than 3/16-inch.
- D. Doors and finish hardware shall be removed and rehung prior to painting.

3.4 FINISH HARDWARE

- A. Finish hardware shall be installed in accordance with hardware manufacturer's standard templates. Operable parts shall be adjusted for proper function and operation.

****END OF SECTION****

SECTION 08347

SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide material and installation of sound control door assemblies in accordance with the Contract Documents.
- B. This Section includes sound-control door assemblies consisting of swinging steel doors, steel door frames, steel window frames, sound-control seals, and related accessories to achieve STC ratings indicated.
- C. Where scheduled, provide sound-control door assemblies listed and labeled to meet fire ratings indicated.

1.2 RELATED SECTIONS

- A. Related Sections include the following:
 - Section 04232 Reinforced Concrete Masonry
 - Section 08710 Finish Hardware
 - Section 09800 Protective Coating

1.3 DEFINITIONS

Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide sound-control door assemblies that have been fabricated and tested as sound-retardant units, are identical to assemblies tested according to ASTM E 90 by an independent testing agency, and have the following minimum certified STC rating according to ASTM E 413:
 - * STC Rating: As indicated in the Door Schedule.

1.5 SUBMITTALS

- A. Product Data: Include sound ratings, construction and hardware preparation details, material and gasketing descriptions, core descriptions, label compliance, dimensions of individual components and profiles, and finishes for sound-control door assemblies.
- B. Shop Drawings: In addition to requirements below, provide a schedule of doors and frames using same reference numbers for details and openings as those on Drawings.
 - 1. Elevations of each door design.
 - 2. Details of sound-control seals, door bottoms, and thresholds.
 - 3. Details of doors including vertical and horizontal edge details.
 - 4. Frame details for each frame type including dimensioned profiles.
 - 5. Details and locations of reinforcement and preparations for hardware.
 - 6. Details of each different wall opening condition.
 - 7. Details of anchorages, accessories, joints, and connections.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
- D. Product Certificates: For each type of sound-control door assembly, signed by product manufacturer.

- E. Qualification Data: For Installer
- F. Field quality-control test reports.
- G. Product Test Reports: Based on evaluation of comprehensive sound-rating tests performed by a qualified testing agency, for each type of sound-control door assembly.
- H. Maintenance Data: For sound-control door assemblies to include in maintenance manuals.
- I. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Acoustical Testing Agency Qualifications: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.
- C. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, through one source from a single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Provide additional protection to prevent damage to finish of factory-finished wood doors.
- C. Deliver frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (100-mm-) high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
- E. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install sound-control wood doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 COORDINATION

- A. Coordinate installation of anchorages for sound-control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry. Deliver such items to Project site in time for installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-control door assemblies that fail in materials or workmanship within specified warranty period.
- B. Failures include, but are not limited to, the following:

- a. Failure to meet sound rating requirements.
- b. Faulty operation of sound seals.
- c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Sound-Control Door Assemblies with Steel Doors:

- a. Ambico Limited.
- b. Amweld Building Products, LLC.
- c. Ceco Door Products; an ASSA ABLOY Group Company.
- d. CURRIES Company; an ASSA ABLOY Group Company.
- e. Firedoor Corporation.
- f. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
- g. Krieger Steel Products Co.
- h. Overly Door Company.
- i. Pioneer Industries.
- j. Security Acoustics; Div. of Security Metal Products Corp.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- D. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- E. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with G60 (Z180) zinc (galvanized) or A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.
- F. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- G. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- H. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound-control door frames of type indicated.
- I. Grout: Comply with Division 04 Section "Unit Masonry."
- J. Grout: Comply with ASTM C 476, with a slump of 4 inches (102 mm) for sound-control door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.
- K. Mineral Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6 to 12 lb/cu. ft. (96 to 192 kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- L. Fire Rating and Labeling: Fire-rated doors and frames shall bear a UL label indicating the type of rating. Design and construction of fabricated products shall

have UL approval for the fire rating indicated. Hollow steel doors and frames for fire-rated openings shall conform to Underwriters' Laboratories listing and shall be UL labeled.

2.3 STEEL DOORS

- A. General: Provide flush-design doors, not less than 1-3/4 inches (44 mm) thick for STC 42 rated doors, of seamless hollow construction, unless otherwise indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges.
- B. Visible joints or seams around glazed lites are permitted.
- C. Bevel both vertical edges 1/8 inch in 2 inches (3 mm in 50 mm).
- D. Core: Manufacturer's standard as required to provide STC rating indicated.
- E. Exterior Door Face Sheets: Fabricated from minimum 0.042-inch- (1.0-mm-) thick, metallic-coated steel sheet.
- F. Interior Door Face Sheets: Fabricated from minimum 0.042-inch- (1.0-mm-) thick, cold-rolled steel sheet, unless otherwise indicated.
- G. Top and Bottom Channels: Minimum 0.053-inch- (1.3-mm-) thick, metal channel spot welded, not more than 6 inches (150 mm) o.c., to face sheets.
- H. Tops and bottoms of doors reinforced with inverted horizontal channels, continuous across full width of door, of same material as face sheets so flanges of channels are even with bottom and top edges of face sheets.
- I. Top and bottom edges closed with closing channels of same material and thickness as face sheets; welded so webs of channels are flush with door edges.
- J. Hardware Reinforcement: Reinforcement plates fabricated from same material as door face sheets to comply with the following minimum sizes:
 - 1. Hinges: Minimum 0.167 inch (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (150 mm) longer than hinge, secured by not less than 6 spot welds.
 - 2. Lock Face Closers, and Concealed Holders: Minimum 0.093 inch (2.3 mm) thick.
 - 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.
- K. Miscellaneous Components: Fabricated from hot- or cold-rolled steel sheet.

2.4 STEEL FRAMES

- A. General: Fabricate sound-control door frames of full-welded unit construction, with corners mitered, reinforced, and continuously welded full depth and width of frame. Knocked-down frames are not acceptable.
 - 1. Exterior Frames: Formed from minimum 0.067-inch- (1.7-mm-) thick, metallic-coated steel sheet.
- B. Hardware Reinforcement: Fabricate reinforcement plates from same material as door frame to comply with the following minimum sizes:
 - 1. Hinges: Minimum 0.167 inch (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (150 mm) longer than hinge, secured by not less than 6 spot welds.
 - 2. Strikes and Closers: Minimum 0.093 inch (2.3 mm) thick.
 - 3. Surface-Mounted Hardware: Minimum 0.093 inch (2.3 mm) thick.
- C. Head Reinforcement: Minimum 0.093-inch- (2.3-mm-) thick, steel channel or angle stiffener.
- D. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed of same material as frame, not less than 0.053 inch (1.3 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide

by 10 inches (250 mm) long; or wire anchors not less than 0.156 inch (4.0 mm) wide.

2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall with throat reinforcement plate, welded to frame at each anchor location.
- E. Floor Anchors: Formed of same material as door frame, not less than 0.067 inch (1.7 mm) thick, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- F. Windows: Window frames shall include anchors and metal stops for glazing. Stops shall be miter-cut and dipped for countersunk flathead fasteners.
- G. Glazed Openings: Glazed openings in door assemblies shall be of sizes indicated, and shall include mitered metal stops. Glazed openings in fire-rated door assemblies shall meet UL requirements. Glass shall conform to Section 08800.
- H. Miscellaneous Components: Fabricated from hot- or cold-rolled steel sheet.

2.5 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with sound-control frames, unless otherwise indicated.

2.6 DOOR HARDWARE

- A. General: Provide manufacturer's standard sound-control system, including head and jamb seals, door bottoms, cam-lift hinges, astragals, and thresholds, as required by testing to achieve STC/Fire rating as indicated. Coordinate hardware with other hardware specified for same door assembly in Section 08710, Finish Hardware.
- B. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
- C. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
- D. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
- E. Mounting: Mortised or semimortised into bottom of door or surface mounted on face of door as required by testing to achieve STC rating indicated.
- F. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
- G. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch (13 mm) when door is fully open; with hardened pin; fabricated from stainless steel.
- H. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum
- I. Finish: Clear anodic finish.

2.7 FABRICATION

- A. General: Fabricate sound-control door assemblies to be rigid and free of defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Steel Doors: Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
- C. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- D. Steel Frames: Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
- E. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
- F. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound-control seal preparations to close off interior of openings and prevent mortar or other materials from obstructing hardware operation or installation.
- * Where installed in masonry, leave vertical mullions in frames open at top for grouting.
- G. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
- H. Jamb Anchors: Provide number and spacing of anchors as follows:
- Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - Two anchors per jamb up to 60 inches (1524 mm) in height.
 - Three anchors per jamb from 60 up to 90 inches (1524 up to 2286 mm) in height.
 - Four anchors per jamb from 90 up to 96 inches (2286 up to 2438 mm) in height.
 - Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
 - Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
- I. Head Reinforcement: For frames more than 48 inches (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
- J. Hardware Preparation:
- Steel Doors and Frames: Factory prepare sound-control doors and frames to receive templated mortised hardware, including providing cutouts, reinforcement, mortising, drilling, and tapping, according to the door manufacturers furnished templates.
 - Reinforce doors and frames to receive non-templated mortised and surface-mounted door hardware as required.
 - Comply with HMMA 830, "Hardware Preparation and Locations for Hollow Metal Doors and Frames."
 - Locate door hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

2.8 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish sound-control steel door assemblies after assembly.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent D. Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).
- F. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control door assemblies.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control door frame connections before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Frames: Install sound-control door frames in sizes and profiles indicated.
- 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.
 - Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, make splice smooth, flush, and invisible on exposed faces.
 - Remove temporary braces only after frames or bucks have been properly set and secured.
 - Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
 - Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
- C. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 04 Section "Unit Masonry."
- 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.
 - Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- D. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.
- A. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
- Jamb: 1/8 inch (3 mm).
 - Head with Butt Hinges: 1/8 inch (3 mm).
 - Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch (9.5 mm).
 - Sill: Manufacturer's standard.
 - Between Edges of Pairs of Doors: 1/8 inch (3 mm).

- E. Sound-Control Seals: Where seals have been prefit and preinstalled in the factory and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.
- F. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.
- G. Thresholds: Set thresholds in full bed of sealant complying with requirements in Division 07 Section "Joint Sealants."

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and adjust operating hardware items just before final inspection. Leave work in complete and proper operating condition.
- B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
- C. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
- D. Clean grout off sound-control door frames immediately after installation.
- E. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- F. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

****END OF SECTION****

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SECTION 08710

FINISH HARDWARE

PART 1 GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all finish hardware and appurtenant work, complete in accordance with the Contract Documents.
- B. The Work hereunder shall include all fabrication and mounting templates as needed for fabricators and for control of application of metal items. In addition thereto, the CONTRACTOR shall provide all trim, attachments, and fastenings indicated or required for proper and complete installation. The Work of this Section shall include all hardware that is not indicated in other Sections, whether or not such hardware is herein specifically scheduled.
- C. The CONTRACTOR shall coordinate hardware with the Work of other Sections. The CONTRACTOR shall furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security, and similar requirements indicated, as necessary for proper installation and function
- D. Section includes mechanical door hardware, and cylinders for doors fabricated with locking hardware.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 07920 – Sealants and Caulking
 - 2. Section 08110 – Steel Doors and Frames
 - 3. Section 08347 – Sound Control Door Assemblies

1.3 REFERENCES

- A. Use date of standard in effect as of bid date.
- B. American National Standards Institute – ANSI 156.18 – Materials and Finishes.
- C. ANSI A117.1 – Specifications for making buildings and facilities usable by physically handicapped people.
- D. ADA – Americans with Disabilities Act
- E. BHMA – Builders Hardware Manufacturers Association
- F. DHI – Door and Hardware Institute
- G. NFPA – National Fire Protection Association
 - 1. NFPA 80 – Fire Doors and Windows
 - 2. NFPA 101 – Life Safety Code

3. NFPA 105 – Smoke and Draft Control Door Assemblies
 4. NFPA 252 – Fire Tests of Door Assemblies
- H. UL – Underwriters Laboratories
1. UL10C – Fire Tests of Door Assemblies (Positive Pressure)
 2. UL 305 – Panic Hardware
- I. WHI – Warnock Hersey Incorporated
- J. State of California Building Code
- K. SDI – Steel Door Institute
- L. NAAM – National Association of Architectural Metal Manufacturers

1.4 SUBMITTALS AND SUBSTITUTIONS

- A. Submittals: Submit six copies of schedule per Section 01300. 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. Use BHMA Finish codes per ANSI A156.18.
 2. Name, part number and manufacturer of each item.
 3. Fastenings and other pertinent information.
 4. Location of hardware set coordinated with floor plans and door schedule.
 5. Explanation of abbreviations, symbols, and codes contained in schedule.
 6. Mounting locations for hardware.
 7. Door and frame sizes, materials and degrees of swing.
 8. List of manufacturers used and their nearest representative with address and phone number.
 9. Catalog cuts.
 10. Manufacturer’s technical data and installation instructions for electronic hardware.
 11. Date of jobsite visit.
- B. Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.
- C. Make substitution requests in accordance with Contract Documents. Include product data and indicate benefit to the Project. Furnish operating samples on request.
- D. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, wiring/riser diagrams, manufacturers’ installation, adjustment and maintenance information, and supplier’s final inspection report.

1.5 QUALITY ASSURANCE

- A. Qualifications:
1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course Work for project hardware consultation to Owner, Architect and CONTRACTOR.

- a. Responsible for detailing, scheduling and ordering of finish hardware
 - B. Hardware: New, free of defects, blemishes and excessive play. Obtain each kind of hardware, latch and locksets, exit devices, hinges and closers, from one manufacturer.
 - C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
 - D. Fire-Rated Openings: In compliance with NFPA 80. Hardware UL10C/UBC-7-2 (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, plus resilient and required intumescent seals. Furnish openings complete.
 - 1. Note: scheduled seals may exceed selected door manufacturer's requirements. See Part 2 - Products for clarification.
 - E. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Convene at least one week prior to commencement of related work.
- 1.6 DELIVERY, STORAGE AND HANDLING
- A. Delivery: coordinate delivery to appropriate locations (shop or field).
 - 1. Permanent keys and cores: secured delivery direct to Owner's representative.
 - B. 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.
 - C. Storage: Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- 1.7 PROJECT CONDITIONS
- A. 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 as the same operation and quality as type specified, subject to Architect's approval.
- 1.8 SEQUENCING AND COORDINATION
- A. Coordinate with concrete.
 - B. Reinforce walls.
 - C. Coordinate finish floor materials and floor-mounted hardware.
 - D. Furnish manufacturer templates to door and frame fabricators.
 - E. Use hardware consultant to check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

1. Confirm that door manufacturers furnish necessary CBC compliant seal packages.

1.9 WARRANTY

- A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' warranties.
 1. Closers: Ten years mechanical.
 2. Exit Devices: Three years.
 3. Hinges: Life of Building.
 4. Other Hardware: Two years.

1.10 COMMISSIONING

- A. Test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
- B. Test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
- C. 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.

<u>ITEM:</u>	<u>MANUFACTURER:</u>	<u>ACCEPTABLE</u>
<u>SUB:</u>		
Hinges	(IVE) Ives	Bommer, Stanley,
Hager		
Key System	(BES) Best	Owner's Standard
Exit Devices	(VON) Von Duprin	Owner's Standard
Locksets	(SCH) Schlage	Best
Closers	(LCN) LCN	Norton 7500 SRI
Kickplates	(IVE) Ives	Hager, Rockwood
Stops & Holders	(IVE) Ives	Trimco, Rockwood
Thresholds	(NGP) National Guard	Pemko, Reese
Seals & Bottoms	(NGP) National Guard	Pemko, Reese

- B. Provide hardware items required to complete the work in accordance with these specifications and manufacturers' instructions.
 1. Include items inadvertently omitted from this specification. Note these items in submittal for review.
 2. Where scheduled item is now obsolete, bid and furnish manufacturers updated item at no additional cost to the project.

2.2 HANGING MEANS

- C. Conventional Hinges: Hinge open widths minimum, but, of sufficient throw to permit maximum door swing. Stainless steel pins and concealed bearings with stainless steel fasteners.
 - 1. Three hinges per leaf to 7 foot, 6 inch height. Add one for each additional 30 inches in height, or any fraction thereof.
 - 2. Extra heavy weight hinges on doors over 3 foot, 5 inches in width.
 - 3. Outswinging exterior doors: non-ferrous with non-removable (NRP) stainless steel pins.
 - 4. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
 - 5. Provide shims and shimming instructions for proper door adjustment.
 - 6. Continuous Hinges of Stainless Steel, both leaves mount between the frame stop and door edge.

2.3 EXIT DEVICES AND LOCKSETS

- D. Exit devices: as scheduled.
 - 1. Lever Trim: through-bolted, Schlage 17A or Security Trim Ives VR900. Filled hollow tube design unacceptable.
 - 2. Strikes: 16 gage. Scheduled Schlage Lock Series L9000.
 - 3. Type: Von Duprin 98 Series with Lever or Security Trim, Ives VR910.

2.4 CLOSERS

- E. General: One manufacturer for closer units throughout the Work.
 - 1. Full rack-and-pinion type cylinder with removable non-ferrous 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. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable.
 - 4. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
 - 5. Opening pressure: Exterior doors 5 lb., interior doors 5 lb., labeled fire doors 5 lb or up to 15 lbs with permission from the Authority Having Jurisdiction.
 - 6. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
 - 7. Closers, interior and exterior are to have a special rust inhibitor on the body and arms.
 - 8. Provide non corrosive fasteners of brass bronze or stainless steel.
 - 9. Non-flaming fluid will not fuel door or floor covering fires.
 - 10. Accepted: LCN 4000 Series, Norton 7500 with forged arms and Rust Inhibitor coating on the body and arm.

2.5 OTHER HARDWARE

- A. Flush Bolts: Automatic, low operating force design with stainless steel fasteners. Provide full width coordinator with fill bars and closer brackets.

- B. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of stainless steel to match other hardware.
- C. Door Stops: Provide stops to protect walls, casework or other hardware with stainless steel fasteners.
- D. Seals: Finished to match adjacent frame color.
- E. Fire-rated Doors, Brush Seals: UL10C/UBC-7-2 compliant. Coordinate with selected door manufacturers and selected frame manufacturer's requirements. Where rigid housed brush 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 and the adhesive applied seal if necessary to fulfill door manufacturer's requirement. Adhesive applied seal alone is deemed insufficient for this project where rigid housed seals are scheduled.
- F. Fire-rated Doors, Intumescent Seals: Furnish fire-labeled opening assembly complete and in full compliance with UL10C/UBC-7-2. Furnished by selected door manufacturer, these seals vary in requirement by door type and door manufacture. Adhesive applied intumescent strips are not acceptable, use concealed-in-door-edge type.
- G. Thresholds: As scheduled and per details. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for approval.
 - 1. Set in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Non-ferrous ¼ inch fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL).
 - 2. Provide manufacturer's non skid surface.
- H. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Provide stainless steel, plated brass or plated bronze fasteners.
- I. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Omit where adhesive mounted seal occurs. Leave no unfilled/uncovered pre-punched silencer holes.

2.6 FINISH

- A. BHMA 630, brush stainless, brushed chrome plated and BHMA 626, Brushed Stainless Steel.
- B. Door closers: Powder coated to Stain Chrome.
- C. Aluminum items: match predominant adjacent material. Seals to coordinate with frame color.

2.7 KEYING REQUIREMENTS

- A. Key Systems: Where indicated in the hardware sets provide the Best interchangeable core in small format in the keyway of record . Where indicated in the hardware sets provide small format interchangeable core in keyway of record, in small format keyed to the existing system in the keyway of record. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers. For estimate use factory GMK charge. Initiate and conduct meeting(s) with Owner to determine system keyway(s) and structure, furnish Owner's written approval of the system.

1. Existing factory registered master key system. Meet with the owner to determine the continuation of the system and establish the keying nomenclature.
 2. Construction keying: brass keyed-alike temporary cores plus 5 operating keys and 2 construction control keys. Temporary cores and keys remain property of hardware supplier.
- B. Keys: Four Keys per cylinder, one Master and Control.
- C. Locksets and cylinders: keyed at factory of lock manufacturer where permanent records are maintained. Locks and cylinders same manufacturer.
- D. Permanent keys and cores: secured shipment direct from point of origination to Owner's representative.
- E. Bitting List: Secured shipment direct from point of origination to Owner upon completion.

PART 3 EXECUTION

3.1 ACCEPTABLE INSTALLERS

- A. Factory trained, certified, and carries a factory-issued card certifying that person as a "Certified Installer". Alternative: can demonstrate suitably equivalent competence and experience.

3.2 PREPARATION

- A. Ensure that walls and frames are square and plumb before hardware installation.
- B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
1. Notify CONSTRUCTION MANAGER of any code conflicts before ordering material.
 2. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

3.3 INSTALLATION

- A. 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.
1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc. 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.
- B. Locate floor stops not more than 4 inches from the wall.

- C. Drill pilot holes for fasteners in wood doors and/or frames.
- D. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4 ADJUSTING

- A. 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 to be repaired or replaced to Owner's satisfaction.
- B. Inspection: Use hardware supplier. Include suppliers with closeout documents.
- C. Follow-up inspection: Installer to provide letter of agreement to Owner that approximately 6 months after substantial completion, installer will visit Project with representatives of the manufacturers of the locking devices and door closers to accomplish following.
 - 1. Re-adjust hardware.
 - 2. Evaluate maintenance procedures and recommend changes or additions, and instruct Owner's personnel.
 - 3. Identify items that have deteriorated or failed.
 - 4. Submit written report identifying problems and likely future problems.

3.4 PROTECTION/CLEANING

- A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.
- B. Clean adjacent wall, frame and door surfaces soiled from installation/reinstallation process.

3.5 SCHEDULE OF FINISH HARDWARE

- A. Manufacturers and their abbreviations used in this schedule:

BES	Best
IVE	H. B. Ives
LCN	LCN Closers
NGP	National Guard Products
SCH	Schlage
VON	Von Duprin

- B. HARDWARE SCHEDULE

Heading 001
 1 SGL DOOR 101 EXTERIOR / PUMP ROOM 101
 1 SGL DOOR 102A EXTERIOR / ELECT. ROOM 102
 3'0" x 7'2" x 1-3/4" x HMD x HMF x NON-RTD
 Opening Remark: STC 42 RATING

Each Assembly to have:

1	EA	CONT. HINGE	700	630	IVE
1	EA	PANIC HARDWARE	9875NL LESS O/S TRIM	630	VON
1	EA	MORTISE CYLINDER	1E64 KEY TO EXISTING MASTER & KEYWAY	626	BES
1	EA	DOOR PULL	VR910M-NL	630	IVE
1	EA	SURFACE CLOSER	4021 H SRI BODY AND ARM/CHANNEL	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	SECURITY FLOOR STOP	FS18L	BLK	IVE
1	EA	DRIP CAP	16SS	630	NGP

Refer to Section 08347 Sound Control Door Assemblies for balance of hardware which will be provided by the Sound Control Door Manufacturer.

Heading 002

1 SGL DOOR 102 PUMP ROOM 101 / ELECT. ROOM 102
3'0" x 7'2" x 1-3/4" x HMD x HMF x NON-RTD

Opening Remark: STC 42 RATING

Each Assembly to have:

1	EA	CONT. HINGE	700	630	IVE
1	EA	PANIC HARDWARE	9875L 996L	630	VON
1	EA	MORTISE CYLINDER	1E64 KEY TO EXISTING MASTER & KEYWAY	626	BES
1	EA	SURFACE CLOSER	4011T SRI BODY AND ARM/CHANNEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE

Refer to Section 08347 Sound Control Door Assemblies for balance of hardware which will be provided by the Sound Control Door Manufacturer.

**** 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, polyvinylidene 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 Fittings 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 International 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. 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.
- B. 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.
- C. Qualification of Painting Subcontractor
 - 1. Copy of a valid State of California license as required for the application of coatings.

2. At least one reference 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 owner 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 OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the 2-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

1.5 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 OWNER. If a proposed substitution requires changes in the Work, bear all such costs involved and the costs of allied trades affected by the substitution at no additional cost to the OWNER.

2.2 INDUSTRIAL COATING SYSTEMS

- A. Material Sources: Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials will be considered as indicated above. All industrial coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater facilities.
 - 1 Tnemec Company, Inc. Local representative: TPC Consultants 310-637-2363
 - 2 Carboline Coatings Company
 - 3 PPG/Ameron

4 International/Devoe

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 OWNER’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 4 - Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material with excellent 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 65 percent by volume. Primer shall be a rust inhibitive two component epoxy polyamide coating with a minimum solids content of 75 percent by volume.
 - a. Prime coat (DFT = 5 mils), Tnemec 66HS, or equal.
 - b. Finish coat (one or more, DFT = 3 mils), Tnemec 1095, or equal.
 - c. Total system DFT = 8 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, Tnemec 66HS, or equal.
 - b. Prime coat, where shop applied. (DFT = 3 mils), universal primer, Tnemec Series 394, or equal.
 - c. Finish coats (2 or more, DFT = 8 mils), Tnemec Series 66HS, or equal.
 - d. Total system DFT = 11 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 – Polyamide Cured Epoxy:** High build, Polyamide-cured, epoxy resin shall have a solids content of at least 75% 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 mils), Tnemec 20HS Pota-Pox, or equal.
 - b. For coating of valves and non-submerged 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. 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 one coat to provide a DFT of 24 mils. The liquid epoxy shall be a 100 percent solids epoxy such as Tnemec FC22 Epoxoline touch-up kits conforming to AWWA C210.
 - (1) Coating DFT = 24 mils, 3M Scotchkote 134 or 206N, or equal.
 - (2) Total system DFT = 24 mils.
 - (3) For coating of valves, DFT = 12 mils.
5. **System No. 108 - Epoxy, Concrete:** The coating material shall be a polyamide-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 75% by volume. When 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 polyamine-cured epoxy material with silica and inert fillers. A 100 percent solids epoxy surface shall be used to fill bug-holes and patch the concrete surface after abrasive blasting.

- a. Prime coat (filler-sealer), applied in one coat to the entire surface using a squeegee to achieve a smooth, void-free surface, Tnemec Series 215 Surfacing Epoxy or equal.
- b. Finish coats (2 or more, DFT = 12 mils), Tnemec Series 20HS Pota-Pox, or equal. On walking surfaces, use a nonskid additive such as 50-70 mesh Aluminum oxide 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. Prefabricated tape shall be Trenton #1 Wax-Tape or equal. The system shall be a 3 part system with a total system DFT = 70 mils to 90 mils. See Section 09952.
2. **System No. 206 – Tape and Cement Mortar Coating:** A flexible pipe dielectric coating system (polyethylene tape) and cement mortar protective overcoat shall be provided. Polyethylene tape shall be per Section 09810. 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 66HS Epoxoline, or equal (8 mils). Total thickness of system DFT= 8 mils.

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 OWNER for consideration during the design phase and upon acceptance by the OWNER 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
Non-buried surfaces of ferrous pipe, fittings, valves, couplings, joints. Excludes steel pipe	White metal blast cleaning SSPC-SP5	(106) fusion-bonded epoxy
Non-buried surfaces of all steel pipe, fittings and appurtenances.	SSP 209-2.2.1	Interior: Cement mortar thicknesses per SSP 209-2.2.1. Exterior: (106) Fusion-bonded epoxy
Buried ferrous surfaces of couplings and valves.	As specified by reference specification	(106) fusion-bonded epoxy and (200) wax tape

Exposed surfaces of equipment, and ferrous surfaces submerged or intermittently submerged in potable water and all surfaces inside enclosed hydraulic structures and vents	Near-White metal blast cleaning SSPC-SP10	(100) Polyamide-cured epoxy
Buried steel pipe 3-inch diameter and smaller	Removal of dirt, grease, oil	(101) cold applied tape
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	(106) fusion-bonded epoxy
Ferrous surfaces in water passages of all pumps which have discharge diameter of 4-inches and larger	White metal blast cleaning SSPC-SP5	(106) fusion-bonded epoxy
Ferrous surfaces of sleeve-couplings	White metal blast cleaning SSPC-SP5	(106) 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-SP16	(8) epoxy
Buried steel pipe, fittings, specials >3" diameter - CMLC &TC	As specified by reference specification	(206) Cement Mortar Lining and coating and Polyethylene Tape Coated per Section 09810. Coating 1" thick. Lining thicknesses per SSP 209-2.2.1
All buried pipe couplings, valves and joints, in addition to epoxy coated surface	As specified by manufacturer of underlying coating	(200) petrolatum/wax tape
Buried ductile or cast iron pipe and fittings	Whitebook Section 209-1.1.2, item #9.	Lining and Coating: (106) fusion-bonded epoxy and (200) wax tape

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.
 9. Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals (SSPC-SP16): A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife.

3.5 METAL SURFACE PREPARATION (UN GALVANIZED)

- 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. The minimum surface preparation shall be abrasive brush blasting per SSPC-SP16.
- B. 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.

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.
- E. After surface preparation, concrete shall have a surface profile in accordance with International Concrete Restoration Institute ICRI-CSP profiles below specific to each product:
 - 1. ICRI 320.1R - Exposed Reinforcing bar (Rebar) Repair
 - 2. ICRI-CSP 1 - Concrete Surface Profile 1
 - 3. ICRI-CSP 2 - Concrete Surface Profile 2
 - 4. ICRI-CSP 3 - Concrete Surface Profile 3
 - 5. ICRI-CSP 4 - Concrete Surface Profile 4
 - 6. ICRI-CSP 5 - Concrete Surface Profile 5
 - 7. ICRI-CSP 6 - Concrete Surface Profile 6

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. Application by brush and/or rollers may require two coats to achieve the specified dry film thickness as compared to spray application.
- I. 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

- J. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables.

DEW POINT CALCULATION CHART

Ambient Air Temperature - Fahrenheit

Relative Humidity	20	30	40	50	60	70	80	90	100	110	120
90%	18	28	37	47	57	67	77	87	97	107	117
85%	17	26	36	45	55	65	76	84	95	104	113
80%	16	25	34	44	54	63	73	82	93	102	110
75%	15	24	33	42	52	62	71	80	91	100	108
70%	13	22	31	40	50	60	68	78	88	96	105
65%	12	20	29	38	47	57	66	76	85	93	103
60%	11	20	27	36	45	55	64	73	83	92	101
55%	9	17	25	34	43	53	61	70	80	89	98
50%	6	15	23	31	40	50	59	67	77	86	94
45%	4	13	21	29	37	47	56	64	73	82	91
40%	1	11	18	26	35	43	52	61	69	78	87
35%	-2	8	16	23	31	40	48	57	65	74	83

SURFACE TEMPERATURE AT WHICH CONDENSATION OCCURS

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 & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Razor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 V. For thicknesses between 10 and 20 mils, a nonsudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water before wetting the detector sponge.
- 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 OWNER.
- 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 OWNER. 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****

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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 in compliance with Section 01300:
 - 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 City's Representative 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 ALTERNATIVE 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 City's Representative. 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 OWNER-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.
- 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 OWNER. 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 OWNER.

****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 in accordance with Section 01300.
- 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 ENCASUREMENT 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 ENCASUREMENT 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****

4. Federal Specifications:

OSHA 1910.144 Safety Color Code for Marking Physical Hazards

5. Regulatory Agency Requirements: Coatings for surfaces in contact with raw or potable water shall impart no taste or odor to the water nor result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations including National Sanitation Foundation (NSF) Standards. All coatings shall be approved by the applicable regulatory agency. The DESIGN/BUILDER shall revise painting systems specified herein to provide manufacturer's regulatory agency approved coating system where required. All painting systems shall be VOC compliant.

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals and Section 09800 - Protective Coating.
- B. List of Paint Materials: Before submittal of color and gloss samples, the DESIGN/BUILDER shall submit a complete list of all paint materials proposed for use, identifying each material by the manufacturer's name, product name, and number. The list shall include all primers, thinners, and coloring agents, together with manufacturer's catalog data fully describing each material as to contents, recommended usage, and preparation and application methods. The DESIGN/BUILDER shall identify surfaces to receive various paint materials and make no deviations from the accepted list. The list shall be submitted within 60 days after execution of the agreement.
- C. Color samples: Color samples and stain samples shall be submitted as required by the CONSTRUCTION MANAGER.
1. Samples of each color and paint finish shall be submitted, using the same substrate materials indicated in the Specifications or shown on the Drawings.
 2. Colors, sheens and texture shall be illustrated.
 3. Size of each sample shall be 8-1/2 inches by 11 inches.
 4. For transparent and stained finishes, samples shall be prepared on the same species and quality of wood indicated in the Specifications or shown on the Drawings, and shall employ the same system of application as specified.
- D. Extra Stock: Upon completion of the project, the CONTRACTOR shall furnish 1 gallon or quart of each type and color of paint, depending on quantity used for the Work.

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR shall verify with the authorities having jurisdiction over air pollution control, the use of any materials containing organic chemical compounds of which use at the date of installation may be prohibited or restricted by any regulations then in effect.
- B. Materials are subject to such tests as the CONSTRUCTION MANAGER may direct.
- C. The number of coats indicated shall be the minimum number acceptable. If full coverage is not obtained with the minimum number of coats, installer shall apply such additional coats as are necessary to produce the required finish, at no extra cost to the OWNER.

- D. The installer shall employ coats and undercoats for all types of finishes in strict accordance with the recommendations of the paint manufacturer unless otherwise indicated in this Section. In case of conflict, comply with the most stringent.
 - E. Testing shall conform to the requirements of Section 09800 - Protective Coating.
- 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers and a list of all batch numbers shall be furnished to the CONSTRUCTION MANAGER before the start of work.
 - B. Stored paints and liquids shall be kept covered, and precautions shall be taken for the prevention of fire. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.
- 1.7 PROJECT CONDITIONS
- A. Finish Coat Coordination: Finish coats shall be provided which are compatible with prime paints used. The CONTRACTOR shall thoroughly review other Sections under which prime coats are to be provided, to ensure compatibility of total coating systems for various substrates. Coordinate communication between the various trades to ensure that each has complete information on characteristics of finish materials proposed for use. Before starting painting, the installer shall notify the CONTRACTOR and the CONSTRUCTION MANAGER in writing of any anticipated problems in use of specified coating systems with substrates primed by others.
 - B. No coating shall be applied: (1) when the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees F; (2) to wet or damp surfaces or in rain, fog or mist; (3) when the temperature is less than 5 degrees F above the dewpoint; or (4) when it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dewpoint within 8 hours after application of coating. Dewpoint shall be measured by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.
- 1.8 SAFETY AND HEALTH REGULATIONS
- A. General: In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the CONTRACTOR shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.
 - B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the Work. In addition, workers engaged in or near the work during sandblasting shall wear OSHA approved eye and face protection devices and air purifying, halfmask or mouthpiece respirators. Barrier creams shall be used on any exposed areas of skin.
 - C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall implement furnish and require the use of approved ear protective devices.
 - E. Illumination: Adequate illumination shall be provided while Work is in progress, which may include explosion-proof lights and electrical equipment. Whenever required by the CONSTRUCTION MANAGER, the CONTRACTOR shall provide additional illumination to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the CONSTRUCTION MANAGER.
 - F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the CONSTRUCTION MANAGER to facilitate inspection and shall be moved by the CONTRACTOR to locations as requested by the CONSTRUCTION MANAGER.
- 1.9 CLEANUP
- A. Upon completion of the Work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the CONSTRUCTION MANAGER. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. All damage to adjacent surfaces or facilities resulting from the Work shall be cleaned, repaired or refinished to the satisfaction of the CONSTRUCTION MANAGER at no additional cost to the OWNER.
- 1.10 WARRANTY INSPECTION
- A. A warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR or its authorized representative shall attend this inspection. All defective work shall be repaired in accordance with the requirements of the Contract Documents and to the satisfaction of the OWNER or CONSTRUCTION MANAGER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection within the contract guarantee period, or may cancel the warranty inspection altogether.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Where alternative painting systems are indicated, selection from among those alternatives shall be the CONTRACTOR 's option.
- B. Substitutions: While architectural paint finishes and related materials are specified herein through the use of proprietary names of specific manufacturers, such reference shall not be construed as intending to limit competition, but rather to establish a minimum standard for kind, quality and function.
 - 1. Alternative finish systems of competing manufacturers shall be considered by the CONSTRUCTION MANAGER for acceptance as substitutions when submitted by the CONTRACTOR, in conformance with procedures and requirements established in Section 01600 - Materials and Equipment.
 - 2. To be approved as an acceptable substitution, the CONTRACTOR's submittal must prove, to the satisfaction of the CONSTRUCTION MANAGER, equivalent or superior quality in components, durability, color, and quality of final appearance.
- C. In proposing a substitution, the CONTRACTOR shall bear the burden of proof of equivalence in material, durability, color, quality and compatibility with related materials. Final judgment of

equivalency and approval of a substitution shall be solely the prerogative of the CONSTRUCTION MANAGER.

- D. Unless otherwise approved by the CONSTRUCTION MANAGER in writing, all coatings applied under a single paint system shall be the products of a single manufacturer.

2.2 FACTORY MIXING

- A. To the maximum extent practicable and, unless otherwise approved by the CONSTRUCTION MANAGER, each paint shall be factory-mixed to the specified color, gloss, and consistency required for application.

2.3 MATERIALS LIST

- A. All paint materials shall be of the following grades or brands, or equals, in each case:

PRIMERS		
<u>Symbol</u>	<u>Generic Group</u>	<u>Trade Name</u>
P1	Masonry Prime Coat (Exterior Waterproofing)	Tamms Industries Col, "Chemstop, H.D.
P2	Masonry, Concrete Sealer (Graffiti Control System)	US Specialty Coatings, Monopole Elastoseal Dunn Edwards, Oxon Masonry Sealer
P3	Masonry, Prime Coat (Interior)	Dunn Edwards, Carboguard 1340 Vista 9800 Protec AE Semi-gloss
P4	Metal Prime Coat	Dunn Edwards, Carbomastic 15 Vista 9600 Protec AE Metal Primer
P5	Masonry Block Filler	Dunn Edwards, Smooth Blocfil Select SBS 100 Smooth Block filler MPI #4 Vista 040 Block Kote Acrylic Block Filler

FINISH COATS		
<u>Symbol</u>	<u>Generic Group</u>	<u>Trade Name</u>
F1	Graffiti Control System	US Specialty Coatings, Monopole Perma Shield Dunn Edwards, Oxon Ultrashield Clear Poly- Urethane Enamel
F2	Masonry Paint	Dunn Edwards, Carboguard 890 Vista 9800 Protec 9800 AE Semi-gloss
F3	Metal Paint	Dunn Edwards Carbothane 134 VOC Vista 9800 Protec AE Semi-gloss
F4	Concrete Floor Sealer	Dunn Edwards Carboguard 1340 Vista Monopole Monochem W20

2.4 PAINTING SCHEDULE

- A. All painting shall conform to the following schedule of finishes, number of coats, and pretreatment requirements. All paint materials listed are keyed to the identifying numbers listed under the Materials List herein.

INTERIOR AND EXTERIOR WORK					
<u>System #</u>	<u>Substrate Material</u>	<u>1st Coat</u>	<u>2nd Coat</u>	<u>3rd Coat</u>	<u>4th Coat</u>
E1	Exterior Concrete	P1	P2	--	--
E2	Exterior Concrete and Block Masonry, Graffiti Control System	P2	F1	F1	F1

E3	Exterior Metal Doors, Frames, Fascia	P4	F3	F3	--
I-1	Interior Masonry	P5/P3	F2	F2	--
I-2	Interior Metal	P4	F3	F3	--
I-3	Interior Concrete	F4	F4	--	--

PART 3 -- EXECUTION

3.1 INSPECTION

- A. The CONTRACTOR's applicator shall thoroughly examine all surfaces scheduled to receive architectural paint finishes, for conditions that will adversely affect execution, permanence and quality of Work.
- B. Starting of application Work shall be construed as applicator's acceptance of substrates, surfaces and conditions within any particular area as appropriate to the successful execution of the Work of this Section.

3.2 GENERAL REQUIREMENTS

- A. Workmanship: Unless otherwise indicated, all paint materials shall be applied by brush or roller in strict accordance with the manufacturer's printed instructions. Spray painting is not allowed without specific approval in each case. Each coat shall be applied at proper consistence, and shall be free of brush or roller marks, sags, runs or any other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces not to be painted shall be avoided. Masking tape shall be applied as required. Sand between each enamel coat.
- B. Coverage Rates: In no case shall paint application exceed the paint manufacturer's published coverage rate based upon unthinned material. In the event that paint has been extended beyond the recommended coverage, or the "hide" produced is inadequate, as determined by the CONSTRUCTION MANAGER, apply one or more additional coats as determined by the CONSTRUCTION MANAGER at no additional cost to OWNER. The manufacturer's recommended amount of thinner shall not be exceeded. Unless otherwise approved, finish coat material shall be applied as taken from manufacturer's container.
- C. Protection: Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers or drop cloths.
- D. Removal of Finish Hardware: Finish hardware shall be removed prior to painting and finishing and re-installed as indicated in Section 08710 - Finish Hardware.
- E. Contrasting Colors: Where painting is to be executed in contrasting colors, edges shall be cut to meet true lines. Holidays and restrikes in painted surfaces shall be sufficient cause for necessitating recoating the entire surface involved. More than one color may be used in any one room.
- F. Barricades: Maintain barricades and wet paint signs for duration of period needed.
- G. Scaffolds: Provide and transfer scaffolds, staging, and planking as necessary for proper performance of Work.

3.3 PREPARATION

- A. General: Prepare surfaces to receive finishes as indicated.

- B. Woodwork: The preparation of the surfaces of woodwork to receive paint shall conform to the following requirements:
 - 1. Painted Surfaces shall be sanded smooth and dusted clean. Nail holes, cracks, or other defects shall be carefully puttied after prime coat using putty which matches the color of the paint. Knots and sappy areas shall be covered with shellac or accepted knot sealer.
 - 2. Putty work shall be knifed; thumb puttying is not allowed. On painted and enameled work, exposed end grain shall be putty-glazed smooth and flush, and shall be allowed to dry before the next coat.
- C. Masonry and Concrete to be Painted: Surfaces of masonry and concrete to be painted shall be dry and free of dust, dirt, grease, oil, and other foreign matter such as loose or granular material. Holes, cracks, joints and any surface defects shall be repaired and filled out flush and smooth with appropriate products, except where a priming coat may be recommended first by the manufacturer of the paint. Glaze and loose particles shall be removed by wire brushing. No evidence of curing compounds, release agents and the like will be acceptable.
- D. Ferrous and galvanized metal surfaces shall be prepared in accordance with the requirements of Section 09800 - Protective Coating.

3.4 APPLICATION

- A. General: Paint shall not be applied in extreme heat, nor in dust or smoke laden air, nor in damp or humid weather.
- B. Drying times shall be not less than called for in manufacturer's printed instructions.
- C. Drop cloths shall be placed where required to protect floors and equipment from splatter and droppings.
- D. Spray painting, where allowed, shall be conducted under controlled conditions, and the CONTRACTOR shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.
- E. Each coat will be inspected by the CONSTRUCTION MANAGER prior to application of the next coat. Areas found to contain runs, overspray, roughness, or other signs of improper application shall be recoated in accordance with the CONSTRUCTION MANAGER's instructions.
- F. The CONTRACTOR shall apply complete paint system required for exposed surfaces behind permanent cabinets, cases, counters, and similar work before such items are installed.
- G. Coats and Colors: Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.5 OUTLINE OF PAINTING AND FINISHING WORK

- A. Exterior: In general, all exposed exterior surfaces of the building shall be painted and finished in accordance with the requirements herein. Exposed surfaces of miscellaneous metal, sheet metal items, mechanical equipment, and all other items, as required, shall be painted with the required primers and coats of paint.
- B. Interior: In general, exposed surfaces of the building shall be painted and finished in accordance with the requirements herein.

- 1 Metal items in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area in which they occur, unless directed otherwise by the CONSTRUCTION MANAGER.
 - 2 Painted doors opening into rooms or spaces having different finishes or colors shall have the edges finished as directed by the CONSTRUCTION MANAGER. Closet and storage room doors shall be finished on both sides to match the room into which they open.
- C. Except as noted below, mechanical and electrical products requiring painting shall conform to the requirements of Section 09800 - Protective Coating. Exposed surfaces, not factory finished, of areas behind grilles, baffles, ventilators, and louvers, that are visible from inside and outside of the building, shall be painted with appropriate primers and one coat of black semi-gloss (low sheen) enamel paint to conceal such areas and spaces when viewed from the floor and ground levels.
- 3.6 ADJUSTMENT AND CLEANING
- A. General: Make a detailed inspection of paint finishes after painting work has been completed, and carefully remove splatterings of paint material from adjoining work of others (particularly plumbing fixtures, trim, tile, and finish metal surfaces), and make good any damage thereto that may be caused by such cleaning operations. Carefully touch-up all abraded, stained, or otherwise disfigured painting work and leave the entire painting work in first-class condition.
 - B. Cleanup and Disposal: During and upon completion of work, remove unused tools and equipment, surplus materials, rubbish, debris, dust and shall leave areas affected by work of this Section in clean approved condition in accordance with the requirements of Section 01700 - Contract Closeout.
- 3.7 TESTING
- A. Testing shall be in accordance with the requirements of paragraph 3.11 of Section 09800 B Protective Coating.
- 3.8 EXTRA MATERIAL
- A. Upon completion of the Work, and as a condition of final acceptance, the DESIGN/BUILDER shall furnish the specified stock of maintenance painting materials to the OWNER. Maintenance painting materials shall be from the same manufacture and color-mixed lots as the materials which are installed. Maintenance materials shall be enclosed in protective packaging with appropriate identifying labels.

****END OF SECTION****

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 all buried metallic piping, fittings and appurtenances not cement mortar coated. 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 in accordance with the Section 01300.
- B. Submit manufacturer's catalog data sheets and application instructions.

PART 2 - MATERIALS

2.1 PRIMER

- A. Primer shall be a blend of petroleum, 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
C. be Trenton Poly-Ply or its approved equal.

2.4. POLYETHYLENE ENCASEMENT

1. See Section 09867

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 and secure around the adjacent pipe circumference with adhesive tape.

****END OF SECTION****

SECTION 10200

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish and install acoustical louvers. Combination louver/dampers, control dampers, fire dampers, adjustable louvers, penthouses, and smoke vents are covered in other sections.
- B. Louvers shall be of the sizes required for opening sizes indicated on the drawings. Actual opening sizes for louvers scheduled for insertion within existing construction shall be field verified. Actual louver sizes shall allow for shim and caulk space.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Building Code (UBC) as adopted by the City of San Diego.

1.4 SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 - 1. Manufacturer's product data including catalogue cuts.
 - 2. Manufacturer's installation instructions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 – PRODUCTS

2.1 ACOUSTICAL LOUVERS

- A. Construction:
 - 1. Material: Mill Finish galvanized steel.
 - 2. Frame: 8" deep x 16 ga. thick channel.
 - 3. Blades: 35° x 22 ga. thick J-style with a 26 ga. thick perforated backing

packed with noncombustible insulating material.

4. Screen: 18-by-16 mesh aluminum insect screen
5. Mullion: Visible.

B. Performance Data:

1. Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.
2. Free Area: 33.1% nominal
3. Free area size: 5.3 ft²
4. Maximum Recommended Air Flow thru Free Area: 808 fpm
5. Air Flow: 4,293 cfm
6. Maximum Pressure Drop: 0.07 in.wg.
7. Water penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 808 fpm free area velocity when tested for 15 minutes.

C. Sound Data:

1. Tested in accordance with ASTM E90.
Octave Band 2 3 4 5 6 7
Center Freq. (hz) 125 250 500 1000 2000 4000
Transmission Loss 7 7 13 20 22 17
Noise Reduction 13 13 19 26 28 23

D. Design Load:

1. Wind Load: Louver designs shall withstand the effects of 30 psf of uniform pressure acting inward or outward.
2. Seismic Performance: Louvers, including attachments to other construction, shall withstand seismic effects determined by ASCE-7.

E. Finishes:

1. Baked Enamel or Powder Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry thickness of 1 mil for topcoat to comply with coating manufacturer's written instructions.
2. Finishes shall meet the AAMA specification 605.2.

F. Acceptable Products:

1. Subject to the requirements specified herein, 8 inch deep acoustical louvers shall be equivalent to Pottorff model SAJ-835 or City approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Products shall be installed in accordance with this section, the manufacturer's instructions, and as indicated on the drawings.
- B. Complete specifications and detailed drawings covering arrangement, dimensions, hardware, accessories, and details of construction and installation of the louvers and vents will be made available to the louver and vent installer.

3.2 INSTALLATION

- A. The louvers shall be installed with anchors suitable for the adjacent material and shall be caulked as specified in Specification Section 07920, "Sealants and Caulking". When required, bird screens or insect screens shall be installed on the louvers.

- B. Where aluminum work is to be attached to steel supporting members or other dissimilar metal, the aluminum shall be kept from direct contact with such metals by a heavy coat of epoxy enamel in accordance with Specification Section 09900, "Painting and Coating". Aluminum surfaces which will be in contact with concrete or masonry when installed shall be given a heavy coat of epoxy enamel. All paint shall be dry and hard when the coated parts are installed.

****END OF SECTION****

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SECTION 10400

IDENTIFYING DEVICES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all signs and other identifying devices and all appurtenant work.

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

1.3 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:

- 1. Shop Drawings: Submit shop drawings for fabrication and erection of identification device. Include plans, elevations, and large scale details of sign wording and lettering layout. Show fasteners, mountings, anchorages and accessory items.
 - a. Furnish location template drawings for supported or anchored to permanent construction.
 - b. Style and colors of lettering shall be as selected by the CONSTRUCTION MANAGER from manufacturer's standards.
- 2. Product Data: Manufacturer's technical data and installation instructions shall be submitted for each type of sign required.
- 3. Samples: The CONTRACTOR shall submit to the CONSTRUCTION MANAGER for approval, samples of all the materials and colors he proposes to use on the WORK. The samples shall be clearly marked to show the manufacturer's name and product identification. Accepted sample units may be installed as part of the WORK, with the CONSTRUCTION MANAGER'S permission.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Wording on all identification devices shall be as per schedule.
- B. Uniformity of Manufacturer: The CONTRACTOR shall furnish products of a single manufacturer for each sign type and graphic image process indicated.

2.2 NAMEPLATES

- A. Nameplates shall be of colored 1/8-inch acrylic plastic plates with matte finish. Lettering shall be white, 1/2-inch high and fused by heat and pressure to a depth of

approximately 0.005-inch. Plates shall be installed in an extruded aluminum frame, medium bronze or dark anodized finish, and plate color and letter style shall be as selected by the CONSTRUCTION MANAGER.

- B. Nameplate schedule shall be as indicated on drawings.

2.3 SIGNS

- A. General: Signs or warnings shall be painted. Paint materials shall be baked enamel on aluminum.

- 1. Signs shall conform to OSHA Standards and directions. Locations, sizes, and colors shall be as reviewed by the CONSTRUCTION MANAGER.
- 2. The lettering sizes shall be 3-inch in height unless shown or specified otherwise.
- 3. Each sign shall be in both English and Spanish as defined below.

- B. Doors: The following sign shall be painted on doors as indicated on drawings:

- 1. EXIT SALIDA

2.4 METAL LETTERS AND NUMBERS

- A. Metal letters and numbers shall be provided in compliance with the requirements indicated for the manufacturing process, materials, finish, style, size and message content.
- B. Letters and numbers shall be formed by casting aluminum to produce characters with smooth, flat faces, sharp corners, precisely-formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of the characters and tap to receive threaded mounting studs.
- C. Baked Enamel Finish: Finish shall be AA-M4xC12C42R1x, manufacturer's standard non-directional mechanical finish including sanding and filing, cleaning with inhibited chemicals, conversion coating with an acid-chromate-fluoride-phosphate treatment and painting with manufacturer's standard organic thermosetting enamel system consisting of a prime coat and a finish coat.

2.5 MISCELLANEOUS LETTERS AND NUMBERS

- A. Plastic: Plastic letters shall be Helvetica Medium lower case cut from 1/4-inch thick acrylic plastic, size as indicated, finished with auto paint coating of color selected by the CONSTRUCTION MANAGER.
- B. Wording: The lettering shall read as indicated. Number shall be verified before ordering.

2.6 MANUFACTURERS

- A. Products shall be of the following manufacture and type (or equal):

- 1. Nameplates:
 - Builders Brass Works, "460 Series"
 - Desk and Door Nameplate Co., "Elite Sign System"
 - Vomar Products, Inc., "ES100 Series"

2. Metal letters:

A.R.K. Ramos
James H. Matthews and Co.
Metal Arts

PART 3 -- EXECUTION

3.1 GENERAL

- A. Identifying devices shall be installed where directed by the CONSTRUCTION MANAGER.
- B. All installations of identifying devices shall be vandal-resistant. Fasteners shall be concealed, non-corrosive fasteners appropriate for materials being fastened and as required.
- C. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
- D. Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

3.2 METAL LETTERS AND NUMBERS

- A. Metal letters and numbers shall be mounted using standard fastening methods recommended by the manufacturer for the letter form, type of mounting, wall construction and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.
 - 1. Flush Mounting: Letters shall be mounted with backs in contact with the wall surface.

****END OF SECTION****

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SECTION 10520

FIRE EXTINGUISHERS

PART 1 -- GENERAL

1. WORK OF THIS SECTION

- A. The CONTRACTOR shall provide material and installation of fire extinguishers in accordance with the Contract Documents.
- B. The WORK of this Section includes providing fire protection equipment, cabinets, and 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 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. California Building Code
 - 2. California 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 Fire Protection Association, Standard No. 10, "Portable Fire Extinguishers" Underwriter's Laboratory, Fire Protection Equipment List

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:
 - 1. Manufacturer's catalogue containing technical data, installation instructions, and details

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- 1. 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.

2. 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 and shall meet the requirements of NFPA Standard No. 10, "Portable Fire Extinguishers"

2.2 FIRE EXTINGUISHERS

- A. Extinguisher shall be 14 lb minimum capacity, CleanGuard 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 BRACKETS AND OTHER MATERIALS

- A. Mounting brackets shall be specially designed for extinguishers.
- 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 DESIGN/BUILDER.

2.4 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.
 6. Ansul (Tyco)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Brackets: All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. 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 05500 Miscellaneous Metalwork
 - 3. Section 09800 Protective Coating
 - 4. Section 11002 Equipment Supports, Grouting and Installation
 - 5. Section 11030 Variable Speed Drives
 - 6. Section 11033 Variable Frequency Drives
 - 7. Section 11175 Pumps General
 - 8. Section 11214 Vertical Turbine Pumps
 - 9. Section 15000 Piping Components
 - 10. Section 15020 Pipe Supports
 - 11. Section 15050 Vibration Isolation
 - 12. Section 16040 Electric Motors
 - 13. Section 260530 Process Instrumentation and Control (PICS) - General

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. International Mechanical Code (IMC)

2. International Plumbing Code (UPC)
3. International Fire Code (UFC)
4. National Electrical Code (NEC)
5. International Building Code (IBC)

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 | Mechanical Vibrations of Shipboard Equipment (Reciprocating Machinery and Propulsion System 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. Provide documentation of 1 recent prior installation. Also provide telephone number 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 OWNER'S MANUAL

A. In addition to the requirements of paragraph 01300-1.5, the following shall be included in the OWNER'S MANUAL submittal in compliance with Section 01300:

1. Manufacturer's catalog including installation instructions.
2. Manufacturer's operating and maintenance procedures including lubricating instructions.
3. Manufacturer's certification that products comply with the indicated

requirements.

4. Bearing L-10 life calculations.
5. Certification that products have been factory-tested and found to conform with the contract requirements.
6. Certification that the WORK has been field-tested and the WORK complies with the indicated requirements.
7. Equipment tolerances.
8. Electrical data including control and wiring diagrams.
9. 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, 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 OWNER'S Personnel:**

1. An authorized service representative of the manufacturer shall instruct the OWNER'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 be qualified 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 in Section 01300, 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 OWNER may videotape the training sessions for later use with the OWNER'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. CONTRACTOR shall provide Certificate of Compliance for all materials in compliance with City of San Diego's "Whitebook" 2015 edition.
- 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 OWNER 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 OWNER's staff, and the production and submission of specified operation and maintenance manuals. The CONTRACTOR is responsible to the OWNER 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:

$$S = Scf \times \frac{(GxDx\Delta\theta)}{2L}$$

where:

S = stress, psi

Scf = stress concentration factor, dimensionless

D = minimum shaft diameter, inches, at point of concentration

ΔK = twist in shaft between adjacent masses, radians

L = effective length between masses, inches

G = shear modulus of material, lb/in²

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, in accordance with Section 01300. 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 torsionograph 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 OWNER 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. Calculations supporting the selection of bearing sizes shall be included in the Owner'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. 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.

2.21 RESERVOIR LEVEL INDICATOR

- A. Level indicator shall have a sliding vertical target with 8" stainless steel or aluminum scale board. Graduated scale shall read one foot for each foot difference in water level. Scale shall have an accuracy of plus or minus 1", shall read in inches and feet and shall have black numbers on a white background. Indicator target shall be 316 stainless steel. Moving parts shall be noncorrosive. Materials inside tank shall be 316 stainless steel.

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.
- 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 OWNER'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 OWNER 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. Installation of equipment anchor bolts shall comply with Section 11002.

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. 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 Surfacing.
ASTM C579	Compressive Strength of (Method/B) Chemical Resistant Mortars and Monolithic Surfacing.
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. Unless noted otherwise, 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 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:

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. 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 Section 11000, 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

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 OWNER'S MANUAL

- A. In addition to the requirements of Section 11000, the following shall be included in the OWNER'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. 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, the requirements of this Section, and the requirements of the individual variable speed drive sections.

****END OF SECTION****

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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 and P-2 have VFD's , Pumps P-3 and P-4 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

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, 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 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 OWNER'S Personnel:** The authorized service representative shall instruct the OWNER'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 OWNER'S personnel shall be conducted separate from the start-up and testing activities. Each of the OWNER'S Trade Groups will be instructed individually, and no more than six hours will be scheduled in one day. Durations of instruction are:

<u>Trade Group</u>	<u>Class Hours</u>	<u>Field Hours</u>
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- 2

A. **General:**

1. Number of drive units - 2
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 1000 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:

$$\text{Efficiency} = \frac{\text{POWER IN (watts)} - \text{LOSSES (watts)}}{\text{POWER IN (watts)}} \times 100\%$$

where losses include input line reactor, rectifier, intermediate circuit, inverter, and output filter.

2. Distribution voltage shall be 480 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 OWNER.

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. 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 inverter
 2. Lights to indicate presence of gate pulses on converter and inverter
 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. Inverter bus voltage
 - e. Current command
 - f. Current feedback
 - g. Converter command
 - h. Filtered inverter bus voltage
 5. Circuitry for the following test modes:
 - a. Manual operation of the inverter 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 (or equal), but shall be modified by the manufacturer as required to meet the indicated features and conditions:
 - 1. Robicon Corporation, Clean Power Series
 - 2. Allen-Bradley
 - 3. ABB
 - 4. Toshiba

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 Section 11030.
- C. **Schedule:**

Variable Frequency Drives

Driven Equipment	Motor Control Center	Horse-Power	Converter
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Tag No.	Name	Tag No.	Circuit No.		Pulses
P-01	Vertical turbine Pump #1			50	18
P-02	Vertical turbine Pump #2			50	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****

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SECTION 11156

MOTOR-OPERATED GATES FOR VEHICLE ACCESS

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of motor-operated gates for vehicle access.
- B. Motor-operated gate shall automatically move entrance gate and control its position in both open and closed directions.
- C. Gate operators shall be heavy-duty industrial type openers as specified herein, and shown on Drawings.
- D. Gate operator entry system shall be initiated via card readers as specified herein.

1.2 RELATED WORK

- A. Section 01300: Contractor Submittals
- B. Section 02800: Fence and Gates
- C. Section 03300: Cast-in-Place Structural Concrete
- D. Section 05500: Miscellaneous Metalwork
- E. Section 09800: Protective Coating

1.3 SYSTEM DESCRIPTION

- A. Furnish and install complete operating motor-operated gate including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Motor-operated gate shall open when remotely activated from exterior of fenced area or when vehicle on interior of fenced area triggers exit loop.
- C. Motor-operated gate control system shall output a continuous signal when the gate is open for any reason.
- D. For swing-type motor-operated gates, a phantom loop shall detect presence of vehicle within swing radius of gate. When phantom loop safety sensor detects presence of a vehicle in gate opening, gate shall remain shut until vehicle clears gate-swing radius.
- E. Following a preset time delay, gate shall close automatically if safety sensor does not detect presence of vehicle.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Operator	Proper Function	Demonstrate smooth quiet operation in compliance with Manufacturer's printed literature	1 test each operator	Contractor	Contractor
Control Inputs and Safety Features	Proper Function	Demonstrate proper functioning	1 test each gate system	Contractor	Contractor

1.5 REFERENCES

- A. NEMA/ANSI 250 Enclosures for Electrical Equipment
- B. NFPA 70 National Electric Code (NEC)
- C. UL325 Door, Drapery, Gate, Louver, and Window Operators and Systems
- D. UL 991 Testing of Safety-Related Controls Employing Solid-State Devices

1.6 SUBMITTALS

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for gates, tracks, rollers and drive chain or rack per equipment shop drawing requirements. Show weight of gate, size and required pull force. Shop drawings shall be site specific, showing existing interferences including neighboring fencing, gates and paved, native or landscaped surfaces and how the gate system will avoid interference from these features.	.
	Electrical drawings required for gate operator per electrically controlled equipment shop drawing requirements. Electrical drawings shall show gate size, gate weight and pull force associated with submitted motor operator.	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements. Include gate operator safety literature and required warning signs.	
Material Samples	Required for finish color	
Motor Data	Required per motor data requirements.	

SUBMITTAL	DESCRIPTION	
Warranty	Furnish three-year warranty from date of final acceptance. Exclusions on warranty shall be limited to physical damage to gate from collision or vandalism. All other conditions shall be covered.	

- B. Refer to Section 01300 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and material samples.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of motor-operated gates shall be strictly followed.

1.8 UNIT PRICES

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

1.9 WARRANTY

- A. Furnish industrial grade gate operator that is maintenance free for 3 years from date of final acceptance. Provide gate and gate operator from single Manufacturer who will accept responsibility for and provide full parts-and-labor warranty for all on-site labor and materials. Exclusions on warranty shall be limited to physical damage to gate from collision or vandalism.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Gate and perimeter fencing	Ameristar Fence Products – High Security Steel Palisade Fence (Impasse II Gauntlet)	Tulsa, OK
	Accepted equal	
Motor Swing Gate Operators	LiftMaster Elite Series Model CSW24U	Elmhurst, IL
	Accepted equal	

- B. Operator unit supplier shall provide all required operator accessories and appurtenances, including vehicle sensing loops, entry systems, and anti-entrapment sensors to ensure compatibility between accessories and provide sole-source responsibility.

2.2 MATERIALS

- A. Work shall comply with UL 325, UL 991 and the National Electrical Code.
- B. Motor-operated gates shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Gate Frame	High-tensile pre-galvanized G-90 steel	Per plans. Welded rigid and watertight connections, Provide diagonal braces and truss rods as needed for stability and preventions of sags and twist. Weight shall be compatible with gate operator furnished.
Gate Operator Cover and Safety Guards	Steel or high-density, UV-resistant polycarbonate	Steel - 16 gauge minimum
Warning Signs	Steel Sheet	Comply with UL325

C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Gate	Style	Double-Leaf Swing Gate
Swing Gate Operator	Maximum Daily Cycle Rate	Continuous
	Class	UL325 Class III Industrial with Limited Access
	Gate Dimensions	See plans
	Drive System	20:1 heavy-duty gear-reduction worm gear with solenoid-activated brake system to prevent back driving. 1-inch minimum solid steel output drive shaft Heavy-duty ball bearings
	Variable Speed	Provide variable speed feature to avoid "jerking" of gate
Hardware	Stops	Provide for each gate
	Keepers	Provide for each gate
	Padlocks	Not required
Gate Closing Safety Features	Covers and Safety Edges	Provide covers on all rotating rollers or equipment. Provide elastomeric safety edge on gate edge to minimize chance of injury
	Sensors Required	Reverse Loop (1 each side) Exit Loop
		Noncontact photoelectric sensors for anti-entrapment protection, including separate transmitter and receiver units, mounting arms, wiring and appurtenances
		Phantom Loop on Swing Gates to detect obstructions
	Sensor Type	Traffic Loop
	Timer to Close	Settable from 0-180 seconds to reset upon receiving additional open commands
	Maximum Run Time	Limit run time to 120 seconds to protect gate and operator from damage.
	Emergency Stop	Provide stop button in weather-tight enclosure to halt gate operation in emergency situation.
Entrapment Warning Alarm	UL325-compliant audible alarm beginning 3 seconds before gate movement and continuing through full gate operation	

ITEM	DESCRIPTION	
	Magnetic Lock Control Relay	Required to activate magnetic lock to secure gate
Gate Controls	Gate Opening	Keypad
	Gate Closing	Automatic with settable timer (0-60 seconds)
	Limit Switches	Adjustable precision snap-action type limit switches to control gate position
	Manual Release	Provide manual release on interior
	Control Circuit	Solid state control board Provide power input "On/Off" switch Provide adjustable timers Provide LED indicators and self-diagnostics Provide adjustable motor current sensing to detect obstructions, with separate adjustments for opening and closing directions. Protect low-voltage control inputs from external spikes and surges providing for control wiring runs up to 1000 feet.
	RF Receiver	Tune to 315 MHz
Warning Signs		Comply with UL 325.

- D. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION	
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant
	Construction	Lockable Enclose manual disconnect, controller, and adjustable limit switches
Control Panel Mounting	Local Mount	See plans
Power Supply	Motor Circuit	120VAC – 1 phase – 60Hz
	Control Panel	120VAC – 1 phase – 60Hz
	Battery Backup	Required
	Convenience Outlet	Built-in 120VAC – 1 phase – 60Hz duplex power receptacle for accessories
	Accessories	Provide transformer for low voltage power Provide fuse-protected 24-VAC and 24 VDC secondary power available on terminal strip for operator accessories including radio receiver and loop detectors

- E. The following product design criteria, options and accessories are required for motors:

ITEM	DESCRIPTION	
Motors	Motor Type	Squirrel cage induction with built-in overload protection
	Operating Frequency	60 Hz with variable speed drive
	Synchronous Speed	1800 rpm (4-pole)
	Speed Control Range	0.1-220 rpm +/-0.1 rpm throughout range

ITEM	DESCRIPTION	
		Paced by 4-20mA input
	Motor Horsepower	½-hp for gates up to 1100 lbs and 25 feet in length / 1-hp for gates up to 1700 lbs and 35 feet in length
	Efficiency	Premium Efficiency
	Starting Code	Manufacturer's standard for motors smaller than 15 hp
	Duty	Intermittent Duty
	Temperature Rise	NEMA Design B Rated for Operation at 50°C (122°F)
	Operating Elevation	730 feet
	Service Factor	1.15
	Insulation	Class F (155°C)
	Overtemperature Protection Motor Windings (motors <200hp)	Provide automatic reset normally closed thermal overloads in each phase of motor windings per NEMA MG-1
	Control Leads on Overtemperature Protection Devices	Color code control leads and terminate in separate conduit box.
	Other Requirements	Insulate and brace windings for full voltage operation.
	Space Heaters (outdoor applications)	not required
	Junction Box	Motor shall have oversized power junction box and auxiliary junction box for overtemperature switch
Motor Bearings	Bearing Life	ANSI/ABMA 9 L ₁₀ of 75,000 hours
Motor Enclosure	Enclosure	WP1
	Description	Drip proof and splash proof
Motor Terminal Boxes	Markings	Permanently mark motor leads in agreement with connection diagram

PART 3 - EXECUTION

3.1 PREPARATION

- A. Make field measurements needed to install motor-operated gates before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Provide conduits with weatherproof metallic electrical junction box adjacent to gate operator as shown on Plans. Provide PVC-coated flexible conduit between junction box and gate opener.
- C. Sawcut pavement at dimensions and depths recommended by loop detector manufacturer, and install loop detector systems specified.

3.2 INSTALLATION

- A. Furnish and install motor-operated gates at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:

1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building, fire, and electrical code requirements
- C. Refer variances between the above documents and Contract Documents to Owner's Representative.
- D. Install motor-operated gates to tolerances recommended by Manufacturer. Unless otherwise shown, install motor-operated gates true, plumb, and level using precision gauges and levels.
- E. Install all provided warning signs securely within view of both sides of gate as required by Manufacturer and UL325.
- F. Prior to equipment operation, provide initial lubrication of all mechanical components. Check all shafts, gears, pulleys, belts, chains, and other moving parts for alignment and tolerances in accordance with Manufacturer's installation instructions.

3.3 FIELD QUALITY CONTROL

- A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Gate and Gate Operator	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner
	Running amperage	Record amperage draw and compare to rated motor FLC	1 test	Contractor	Contractor
Gate Operator	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed Literature	1 test	Contractor	Contractor
	Entrapment Protection Provisions	Test each entrapment protection provision separately with other entrapment protection provisions defeated.	1 test each entrapment protection provision	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

- B. Provide services of factory-authorized representative on-site to provide the following:
1. Installation assistance, inspection and startup of the complete motor-operated gate system.
 2. Field testing and adjustment.
 3. Instruction of Owner's personnel in operation and maintenance. Although maintenance is covered by warranty for the first five years, the Owner

reserves the right to perform itemized scheduled maintenance functions listed on factory operations and maintenance manuals.

****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

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-DI.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 1 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 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.

3. 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
4. Documentation of certification in accordance with ISO 9001 as specified under paragraph 11175-2.1A.
5. 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.
6. Motor submittal information as specified in paragraph 16040-1.5. In addition, this information shall include calculations for motor rotor and frame reed frequencies.
7. 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.
8. Drawings showing general dimensions and confirming the size of pumps, motors, drives, and specified appurtenances; piping connections; construction details of equipment; wiring diagrams; and weight of equipment.
9. Variable-speed drive information as required under Sections 11030 and 11033.
10. 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.
11. 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.

12. Vibration measurement results as specified in paragraph 11175-3.5.

1.5 OWNER'S MANUAL

A. In addition to the requirements of Section 11000, the following shall be included in the OWNER'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 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, 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) OWNER-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 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 ANSI/HI 14.6.
4. Factory Witnessed Tests: Unless otherwise specified with no exception, pumps, 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 OWNER.
5. 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.
6. 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 OWNER, until found satisfactory.
7. All test results (data sheets, test logs and generated performance curves) shall be signed and certified correct by the test facility of the manufacturing corporation.
8. 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 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.
9. 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, within pump preferred operation range.

- 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 Owner'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 a 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 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 Division 26 Sections.
- B. 6 Hour Field Test: Demonstrate compliance to contract documents and manufacturer's printed literature. Conform to HI 14.6 to extent possible in field. These tests shall be witnessed by the pump supplier's factory authorized representative who shall certify installed pumping system complies with the contract documents and manufacturer's warranty requirements, that interlock and control features work properly and that no drive equipment or shafting is overloaded at any point on the published pump curve. One 6 hour test for each pump shall be performed.

- C. Vibration: Running test with vibration analyzer per ANSI/HI 14.6. Don't exceed published HI standards or 0.20 in/sec RMS in absence of HI standards. Perform 1 test for each pump during a 6-hour field performance test. For VFD driven pumps, test each pump at four 100 RPM increments.
- D. Motor Current: Record current in each phase of each motor and include in O&M manual. Repair or replace motor or motor driven equipment if current exceeds motor nameplate FLC value.
- E. 11 month warranty inspection: Demonstrate compliance to contract documents and manufacturer's printed literature.
- F. Additional field testing requirements are specified in Section 11000, Part 1, and may be specified in the individual equipment specifications.
- G. 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 AWWA E101. 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. 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 cavitation or damaging vibration over the entire specified range of flow and head conditions, within the pump's allowable operating range.

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. **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 Section 11175-2.2.

3. **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.
4. **Bearings:** Unless otherwise specified, anti-friction bearings shall be selected for an AFBMA L-10 of at least 50,000 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. **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.

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. **Tools:** Tools shall comply with Section 11000 and shall include one pressure grease gun for each type of grease required for pumps and motors.
- D. **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.
- E. **Nameplates:** Nameplates shall comply with Section 11000 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. See section 11214, Vertical Turbine pumps for materials associated with the 4 pumping units. 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. Bronze Pump Impellers (where indicated): ASTM B 62 or ASTM B 584. Bronze shall have the following chemical characteristic:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper+Nickel+Silicon	83% maximum

4. Pump Shafts: Stainless steel, Type 316 unless higher strength is required.
5. All shaft sleeves for packed boxes, fretting seals and inter-stage seals shall be Type 416 stainless steel.
6. Miscellaneous Stainless Steel Parts: Type 316
7. Internal Fastener Parts of All Types in Wetted Areas: Type 316 stainless steel.
8. Discharge Heads and Suction Cans: Carbon steel conforming to the requirements of AWWA E101.
9. Anchor Bolts, Nuts and Washers: Materials shall be as specified in paragraph 11000-2.20.

2.3 SUMP PUMP

- A. **Sump Pump:** The sump pump (located in the pump station building) shall be a ½ Hp, 115 volt, single phase, oil filled, submersible pump. The pump shall be capable of pumping 30 gpm at 36' TDH and pass a 2" spherical solid. Pump shall have automatic operation with a float operated switch, stainless steel float guard and float arm. Pumps shall be hermetically sealed to be watertight. Pump base, housing and cap shall be cast iron. Impeller shall be bronze and the non-clogging vortex type. Cord shall be UL listed. Pump shall be Zoeller or approved equal.

2.4 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 260531 and shall be mounted at a location selected to minimize the effect of vibrations.
- C. **Pump Suctions:** Pressure gauges shall be installed at pump suction. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached using 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 and 11033.
- E. **Local Control Panels:** The NEMA rating of local control panels shall comply with the area designations, unless indicated otherwise.
- F. **Lifting Eyes:** Pumps and nozzles shall be provided with lifting eyes to permit removal and/or disassembly.

2.5 PUMP REQUIREMENTS

- A. Pumps shall comply with the following:
 - 1. **Lubrication:** Except as otherwise indicated, line shaft bearings of vertical turbine mixed flow 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 International 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
 - 6. **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.

2.6 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 0.008-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.

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 AWWA E101. All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be included in the Owner's Manual.

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.

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 0.008-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.

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 conform to ANSI/HI 14.6 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 Owner'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, 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.
- 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 and 11033 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.

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 and 11175. Where this Section is silent on any subject, item or equipment, the requirements of Section 11175 shall govern.

1.4 SERVICES OF MANUFACTURER

- A. Services of the manufacturer shall be provided in accordance with Section 11175 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 OWNER'S Personnel:** The authorized service representative shall instruct the OWNER'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 OWNER'S personnel shall be conducted separate from the start-up and testing activities. Each of the OWNER'S Trade Groups will be instructed individually, and no more than six hours will be scheduled in one day. Durations of instruction are:

<u>Trade Group</u>	<u>Class Hours</u>	<u>Field Hours</u>
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 1 projects with vertical turbine pump installations, which meet the experience requirements, indicated below. Include the following information for each project:
 - a. Name of facility, owner of facility, contact name, address, and telephone number.
 - b. Fluid pumped, capacity, head, horsepower, and speed.
 - c. Pump model number and size.
 - d. Year installed.
 - e. Local Maintenance Facility Qualifications: Service facility name, address, telephone number, and name of responsible manager. Experience record of local facility.
- C. CONTRACTOR shall submit the Vertical Turbine Pump Data Sheets with relevant information completed to the maximum extent possible.
- 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.
- 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. Submit data to City for review.
- J. Each pump shall be tested with its respective job motor.
- K. 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.
- L. Submit written documentation on regarding pump coating materials, surface preparation, and application procedures.
- M. 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.
- N. In addition furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for pumps. Show bowls, impellers, drive assemblies, shafts, bearings, seals, columns, discharge heads and shaft guards per equipment shop drawing requirements Show fabrication, assembly, foundation and installation requirements.	
	Required for motor and motor controls under electrically controlled equipment shop drawing requirements	
	Required for anchor bolts. Show placement, embedment, and edge distances. Show embedment distances and projections from concrete face.	
	Show lining and coating data and thicknesses.	
Catalog Data	Required per catalog data requirements. Include pump curves.	
Pump Curves	Submit pump curves with specified operating points marked. Curve shall also show required submergence and NPSHR	
Installation Instructions	Required per installation instruction requirements	
O & M Instructions	Required per operation and maintenance instruction requirements	
Certificate of Compliance	Submit pump system certification per certificate of compliance requirements of AWWA E103 and specifications	
	Submit coating system certification per certificate of compliance requirements	
Engineering Calculations	Required for bearing spacing, shaft critical frequency and calculated bearing life.	
Manufacturer's Statement of Responsibility	Required per Manufacturer's statement of responsibility requirements Include statement that pumps installed comply with Contract Documents.	

SUBMITTAL	DESCRIPTION	
Test Record Transcripts	Before shipping pumps, submit certified six-point pump curves for factory tests per test record transcript requirements. Where variable speed drives are provided, submit certified six-point pump curves in four 100 rpm increments throughout the operating range of the pump. Include a written report stating the date and location that the pumps were tested and certifying in accordance with AWWA E103 that certified pump curves are accurate and comply with specifications.	
	Before shipping pumps, submit certified vibration test report including test results stating that pump and motor assembly has been tested and vibration falls within limits allowed by HI 2.6 and above	
Motor Data	Required per motor data requirements.	
Testing Procedures	Submit written test procedures in advance of all field pump tests.	
Warranty	Furnish five-year warranty from date of final acceptance for all pumps and motors. Warranty shall bear appropriate serial numbers.	

1.6 QUALIFICATION REQUIREMENTS

- A. The pump manufacturer shall be experienced in the manufacture of canned vertical turbine pumps. At least 1 successful project involving 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 5 years which starts on the date of approval of proper pump operation. 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 and shall be a witnessed test.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Environmental conditions:

Service	Indoors environmental temperature range of 35°F to 105°F
Elevation	705 feet above mean sea level
Relative humidity	10% to 90%
Liquid pumped	Potable water

Fluid temperature range	64°F to 80°F
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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	Constant Speed
Vertical Turbine Water Pump	P-04	Constant Speed

2.3 PUMP DATA

A. Pumps P-1 and P-2

Pump	P-1 and P-2
Maximum pump speed	1,770 rpm
Motor horsepower (minimum)	50 hp
Motor type	Per Section 16040
Pump lubrication	Open Lineshaft (water)
Discharge connection size	6 inches
Minimum column size	5 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 and P-4

Pump	P-3 and P-4
Maximum pump speed	1,770 rpm
Motor horsepower (minimum)	75 hp
Motor type	Per Section 16040
Pump lubrication	Open Lineshaft (water)
Discharge connection size	10 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

2.4 PERFORMANCE REQUIREMENTS

A. Pump P-1 and Pump P-2 (VFD's)

Pump Design Conditions

At 1770 rpm:

Condition A: Shutoff Head Operation

Capacity, gpm	0
TDH, ft	557

Condition B: Maximum Flow Operation

Capacity, gpm	430
TDH, ft	232
Bowl Efficiency (min) %	60

Condition C: 2 pumps operating in parallel

Capacity, gpm	850
TDH, ft	232
Bowl Efficiency (min) %	61

At Reduced Speed:

Condition D:

Capacity, gpm	38
TDH, ft	230

B. Pump P-3 and P-4 (constant speed pumps)

Operating Condition

At 1770 rpm:

Condition A: Shutoff Head Operation

Capacity, gpm	0
TDH, ft	485

Condition B: Maximum Flow Operation

Capacity, gpm	880
TDH, ft	232
Bowl Efficiency (min) %	60

Condition C: 2 pumps operating in parallel

Capacity, gpm	1725
TDH, ft	244
Bowl Efficiency (min) %	80

Notes:

1. Condition A shall be taken as the rated, continuous-duty operating condition with the pump operating **against shutoff 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 shall be taken as the **rated, continuous-duty maximum head condition**. Condition B 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 B 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.
3. Condition C is similar to Condition B and presented to indicate 2 pumps operating in parallel.
4. Condition D head is presented to indicate operating conditions when the pump is operating at **minimum anticipated system head**, at a reduced RPM assuming a hypothetical head-capacity curve. Condition D 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.
5. The capacity of the pump station with all 4 pumps running at full speed shall be 2,480 gpm at 260' TDH.
6. 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.

2.5 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.
- B. At any operating speed, the pump's natural frequency shall be at least 20% below pump operating speed, or at least 30% greater than pump operating speed. 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).

2.6 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	AISI 416 stainless steel or approved equal AISI 410 stainless steel couplings or equal
Bowl wear rings	Stainless steel, ASTM A743, Grade CF-8M or CA-15 or ASTM A276, Type 410 or bronze per paragraph G below.
Bearing retainers (fabricated integral)	Carbon steel, ASTM A283, Grade B.
Bearing retainers (insert type)	Bronze; see paragraph G below.
Lineshaft bearings	Cutless rubber
Impellers	Bronze per paragraph G below.
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
Mechanical Seals	Tungsten or Silicon Carbide
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; see paragraph G below.
All parts made of fabricated steel including discharge head for Pumps P-1 and P-2.	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. Min. 150 psi
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 paragraph G below.

- D. All static components of the pump shall be coated and lined with 24 mils fusion bond epoxy. Unless otherwise specified, any other material shall be coated and lined per Section 09800.
- 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 coupling guards conforming to CAL/OSHA requirements.
- G. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

2.7 EQUIPMENT

- 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 for pumps P-3 and P-4, shall be fabricated steel for pumps P-1 and P-2 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.

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 and P-2 and 4 fps for Pumps P-3 and P-4, 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 this Section 2.4.D.
- 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 flange to allow metal-to-metal contact.

2.8 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

2.9 MANUFACTURERS

- A. Acceptable manufacturers include the following modified as necessary to meet the requirements indicated herein, or approved equal:

1. Peerless Pumps
2. Floway
3. Fairbanks Morse
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.
- C. Instruction of OWNER's Personnel: The training representative of the manufacturer shall be present to furnish the services required by Subsection 1.4.
- D. Provide Certificate of Warranty, written verification that all pumping units are installed correctly, according to the manufacturer requirements.
- E. For the purposes of this Section, a work day is defined as an eight hour period at the site, excluding travel time.
- F. The CONSTRUCTION MANAGER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

3.2 RESPONSIBILITIES 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. 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.
- C. Field testing shall be per section 11030.

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 Section 1.7 of these Specifications.

****END OF SECTION****

SECTION 11268

RESERVOIR HYDRODYNAMIC MIXING SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of a hydrodynamic mixing system for the Soledad reservoir.

1.2 RELATED WORK

- A. Section 01300: Contractor Submittal
- B. Section 03300: Cast-in-Place Structural Concrete
- C. Section 05500: Miscellaneous Metalwork
- D. Section 09800: Protective Coating

1.3 SYSTEM DESCRIPTION

- A. The Hydrodynamic Mixing System (HMS) is defined as a supplemental system installed within a potable water storage reservoir which passively utilizes the energy provided by the inlet water supply (via pumped or gravity head) and generates a sufficient inlet momentum to achieve a complete homogeneous blending of the water volume within the reservoir with the inlet supply flow. Determination of Complete Homogeneous Blending shall be defined by the modeling requirements and supporting hydraulic analysis as conducted by each individual manufacturer for their specific system configuration as defined within these specifications. System submittals not providing this validation shall not be considered as a viable Hydrodynamic Mixing System (HMS) and shall not be accepted as an equivalent to this system specification.
- B. The specifications in this section include all components of the Reservoir Hydrodynamic Mixing System (HMS) consisting of a bi-directional flow manifold equipped with variable orifice duckbill inlet nozzles and outlet flow check valves that are NSF61 certified. The HMS manufacturer shall be responsible for designing the system in accordance with the hydrodynamic criteria defined within these specifications and submit design calculations verifying compliance in accordance with the submittal requirements. The following is a description of the Hydrodynamic Mixing System.
- C. All modeling and hydraulic and mixing calculations pertaining to the HMS shall originate from the duckbill valve manufacturer. Modeling and calculations provided by parties other than the duckbill valve manufacturer are not allowed.
- D. The complete Hydrodynamic Mixing System shall be supplied by the variable orifice nozzle manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, variable orifice duckbill check valves, and any other equipment specified within this section of the specifications.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 REFERENCES

- A. ANSI B16.5 – Pipe Flanges and Flanged Fittings
- B. ANSI B36.10 – American National Standard Weights and Dimensions of Welded and Seamless Wrought Steel Pipe
- C. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- D. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- E. AISI 304 – 304 Stainless Steel Plate
- F. AISI 316 – 316 Stainless Steel Plate
- G. AWWA C200 – Standard for Steel Water Pipe 6” and Larger
- H. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service – Size 4” to 144”
- I. AWWA C220 – Standard for Stainless Steel Pipe, 4” and Larger
- J. American Water Works Association Research Foundation (AWWARF)
 - 1. Project No. E20-J08 – Physical Modeling of Mixing in Water Storage Tanks (Forthcoming)
- K. NSF Standard 61 – Drinking Water System Components – Health Effects

1.6 SUBMITTALS

Contractor shall furnish the following submittals.

- A. Independent CFD Modeling Validation
 - 1. The mixing system designer/supplier must supply data or report from at least one project where an independent company conducted CFD modeling on their mixing system design and the modeling results verified the design achieved complete mixing.
- B. Full Scale Tracer Study Validation
 - 1. The mixing system designer/supplier must supply data or report from at least one project where a full scale tracer study using calcium chloride was conducted on a circular reservoir and the tracer study results verified the mixing system design achieved complete mixing.
 - 2. The mixing system designer/supplier must supply data or report from at least one project where a full scale tracer study using calcium chloride was

conducted on an elevated tank and the tracer study results verified the mixing system design achieved complete mixing.

C. Inlet Nozzle Valve (Duckbill) Testing and Validation

1. Verification of independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2" through 48". The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.
2. Verification of Independent Laboratory Testing for Manufacturing Consistency - the duckbill valve manufacturer shall provide summary documentation of a report conducted by an Independent Laboratory for hydraulic testing where multiple duckbill valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability and consistency of the manufacturing process to produce the same hydraulic characteristics.
3. Report of independent testing that studied the flow distribution characteristics of duckbill valves installed on multiport manifolds. The manufacturer must have been in the business of manufacturing duckbill valves at the time the report was published.
4. Verification of Finite Element Analysis (FEA) of duckbill valves. The duckbill valve manufacturer shall provide summary documentation of Finite Element Analysis modeling on representative duckbill nozzle sizes to determine deflection, stress and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.
5. Verification of independent hydraulic testing to determine headloss characteristics on a minimum of three (3) sizes of perforated disc/elastomeric membrane check valves ranging from 6" through 36". Testing must have been conducted with and without the membrane installed. At least two (2) sizes shall have tested two (2) different membrane thicknesses.
6. Verification of Finite Element Analysis (FEA) modeling on a perforated disc/elastomeric membrane check valve to determine stress and deflection characteristics under reverse differential pressure.

D. Validation of Long-term performance

1. The mixing system designer/supplier must supply at least one inspection report showing proper operation of, and no deterioration of, the duckbill valves after being in service in a water storage tank mixing application.

E. NSF61 Certification

1. Copy of the NSF61 Certified listing for the valves used in the Hydraulic Mixing System (HMS).
2. The valves themselves must be NSF61 certified, not just the elastomer used in construction of the valves. NSF61 approved/certified materials will not be accepted in lieu of valve certification.

3. The NSF61 Certification for the valves must be for a minimum volume of 2,000 gallons. Valves with NSF61 Certification for minimum volume of greater than 2,000 gallons are not acceptable.
- F. Test Report on Elastomer Exposure to Chlorine and Chloramine
1. Copy of test report from an accredited independent laboratory that confirmed here is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."
- G. System Installation Drawings
1. The duckbill valve manufacturer shall be responsible for providing engineering installation drawings of the complete manifold piping system as supplied by the manufacturer. These drawings shall include plan view piping arrangement, sections and elevations as required, support bracket installation details, duckbill nozzle orientation details, and all dimensions required for locating the system within the specified dimensions of the tank.
 2. Six (6) sets of plans shall be provided to the Engineer for review and approval.
 3. Two (2) sets of final fabrication and installation drawings shall be included with the shipment of the manifold piping equipment.
- H. Design Calculations
1. All Design Calculations, curves, and reference information listed below must originate and be submitted by the duckbill valve manufacturer. Calculations, curves, and reference information provided by contractors relating to the HMS are not allowed. The duckbill valve manufacturer MUST include within the submittal package the following design calculations, curves, and reference information:
 - a. Calculations showing the fill time required, under isothermal conditions, for the HMS system to achieve complete mix of the reservoir volume at minimum, average and peak fill rates. Complete mixing defined as 95% homogenous solution. The theory and equations used in calculating the mixing times must be from a published AWWA reference manual or paper. The reference document(s) must be submitted with the equations and calculations.
 - b. Calculations showing the water level drawdown required to achieve complete mixing on the fill cycles at minimum, average, and peak flow rates.
 - c. Calculations of average storage tank water age for both fill-then-draw, and simultaneous fill and draw scenarios. Theory used in calculating water age must be submitted with the calculations.
 - d. A representative Computational Fluid Dynamics (CFD) model evaluation of the proposed HMS system configuration applied within a reservoir of similar geometry. Model output documentation shall include all design variables applied for the simulation, plot of the 3-D geometry showing the mesh definition, velocity magnitude vector and contour plots at different cross-sections throughout the water volume, simulated tracer animations showing

- the spatial and temporal distribution of inlet water in real time during the fill cycle.
- e. Hydraulic calculations showing the resulting jet velocities of each inlet nozzle at minimum, average, and peak fill rates.
 - f. Hydraulic calculations showing the flow distribution among all inlet ports at minimum, average, and peak fill rates.
 - g. Manifold hydraulic calculations showing the total headloss of the HMS at minimum, average, and peak fill and draw rates. Headloss shall include all minor losses and headloss of nozzles and outlet check valves.
 - h. Hydraulic curves showing thrust vs. flow for the inlet nozzles.
 - i. Hydraulic curves for each outlet check valves showing headloss vs. flow.
 - j. Calculations showing the terminal rise height of the jets that discharge at an angle above horizontal. The terminal rise height shall be calculated assuming 10°F and 20°F colder inlet water and calculated at minimum, average and peak fill rates. The theory and equations used to calculate the terminal rise height shall be included.
 - k. Hydraulic curves for each inlet nozzle of Densimetric Froude number vs. flow
 - l. If the calculations and supporting data provided do not show compliance with the hydrodynamic requirements of the system as interpreted by the Engineer or Owner then the submittal shall be rejected.
2. Within 30 days of final approval of the installation drawings, by the Engineer, the HMS valve manufacturer shall provide four (4) sets of the installation portion of the Installation, Operation and Maintenance (IOM) Manuals for the applicable system. Within 30 days of final approval, by the Engineer, of the installed system the manufacturer shall provide six (6) copies of the complete Installation, Operation and Maintenance (IOM) Manual for final review and approval. The manuals shall be in the following format and include the listed required information as a minimum:
 - a. Enclosed in a 3-ring binder with project title and system designation shown on the front cover and side binder.
 - b. Table of contents
 - c. Copy of design calculations for the manifold system as defined in the previous section.
 - d. Copy of complete set of the installation plans.
 - e. Copy of NSF61 Certified Listing for the valves
 - f. Parts and equipment list with specification numbers for ordering of replacement parts.
 - g. Product specification sheets for nozzles, outlet valves, expansion joints, concrete anchors, and any other specialized items supplied with the system.

- h. Installation guidelines for the HMS manifold system.
- i. Operational procedures for the HMS manifold system.
- j. Guidelines for repair of system components.
- k. Schedule for suggested periodic maintenance of the manifold system.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Individual nozzles and outlet valves shall be packaged separately from the piping equipment.
- B. All flanges shall be protected by using plastic inserts or plank wood, pipe sections are to be fully supported to prevent pipe deflection or damage to fittings or connections.
- C. All equipment shall be shipped on pallets capable of fully supporting the pipe sections across their entire length. Pallets should be accessible for fork lift transport or strap and hoist means without causing any load to the pipe equipment.
- D. All stainless steel components shall be stored separately away from any carbon steel components or other materials that could stain or deface the stainless steel finish from run-off of oxidized ferrous materials.
- E. All pipe equipment should be covered and stored in areas free from contact with construction site sediment erosion to prevent accumulation of materials within the pipe and fittings.
- F. Duckbill nozzles should be protected from contact with rigid objects during handling and storage. The Contractor shall be responsible for replacing any duckbill nozzles or elastomeric components that are damaged after arrival on the site through installation and start-up of the system.

1.8 UNIT PRICES

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

1.9 WARRANTY

- A. The complete manifold piping system shall be supplied by the HMS manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, duckbill valves, and any other equipment specified within this section of the specifications.
- B. All piping, pipe support brackets, joint connections, expansion joints, and anchors shall be warranted by the HMS manufacturer against failure under design conditions for a period of one (1) year from the date of final installation approval by the Engineer.
- C. Inlet nozzles and outlet valves shall be warranted by the manufacturer against failure under design operating conditions for a period of one (1) year from the date of final installation approval by the Engineer. Elastomer components damaged as a result of

maintenance activities, foreign debris, or excessive exposure to direct ultraviolet and thermal radiation shall be excluded warranted coverage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Reservoir Hydrodynamic Mixing System (HMS)	Tideflex Technologies	Carnegie, PA
	Accepted equal	

B. Manufacturer's and/or contractors submitting an alternative to the named Tideflex Technologies mixing system shall be responsible for obtaining any and all proprietary rights, license fees, royalties, technology licenses, and/or permissions required to provide such a system. The Manufacturer shall indemnify and hold harmless the City and Engineer against all claims, damages, losses, and expenses arising out of any infringement of patent rights or copyright incident relating to this system.

2.2 MATERIALS

A. Variable Orifice Duckbill Inlet Nozzles

1. Inlet ports/nozzles shall be duckbill-style check valves that allow fluid to enter the reservoir during fill cycles and prevent flow in the reverse direction through the nozzle during draw periods. Inlet ports/nozzles may not be fixed-diameter ports or pipes.
2. The duckbill valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.
3. Inlet ports/nozzles shall have a variable diameter vs. flow hydraulic profile that provides a non-linear jet velocity vs. flow characteristic and a linear headloss vs. flow characteristic. The hydraulic characteristics of the duckbill valves shall be defined by "Hydraulic Code"
4. The inlet ports/nozzles shall discharge an elliptically shaped jet. The nozzle must have been modeled by an independent laboratory using Laser Induced Fluorescence (LIF).
5. Manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2" through 48". The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.
6. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.

7. Manufacturer shall have conducted independent hydraulic testing to study the flow distribution characteristics of duckbill valves installed on multiport manifolds.
 8. Manufacturer to have conducted Finite Element Analysis (FEA) on various duckbill valves to determine deflection, stress, and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.
 9. Manufacturer must have conducted in-house backpressure testing on duckbill valves ranging from ¾" to 48".
 10. Manufacturer must have duckbill valves installed on manifold piping systems in at least 100 distribution system reservoirs.
 12. Manufacturer must have representative inspection videos showing the duckbill valves discharging water into the reservoir during an initial fill (unsubmerged). Manufacturer must also have representative underwater inspection videos showing the operation of the valves when submerged. Representative videos can be submitted upon request from the engineer.
 13. The duckbill style nozzles shall be one-piece elastomer matrix with internal fabric reinforcing designed to produce the required discharge velocity and minimum headloss requirements as stipulated in the Submittals section. The flange portion shall be an integral portion of the nozzle with fabric reinforcing spanning across the joint between the flange and nozzle body.
 14. The elastomer used in construction of the duckbill valves must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."
 15. The manufacturer's name, plant location, serial number and product part number which designates nozzle size, material and construction specifications shall be bonded onto the surface of the nozzle.
- B. Outlet Check Valves (Not in Project)
1. The outlet flow valves shall be perforated disc type with elastomeric membrane.
 2. The valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.
 3. The perforated disc shall be fabricated of stainless steel plate with welded support gussets. The disc shall be flanged and drilled to mate with ANSI B16.1, Class 125/ANSI B16.5 Class 150 flanges. The disc shall have three (3) tapped holes used for fastening the membrane and support rod to the disc with stainless steel bolts, nuts, and lock washers. The top of the disc shall be tapped and supplied with lifting eyebolt for installation.
 4. The membrane shall be circular, one piece rubber construction with fabric reinforcement. The diameter of the membrane shall allow adequate clearance between the membrane O.D. and the pipe I.D. The membrane shall be vulcanized with a specified convex radius to produce a compression

set to allow the membrane to seal against the perforated disc at low reverse differential pressure.

5. The support rod shall be stainless steel and drilled with three (3) longitudinal holes to allow fastening of rod to membrane and perforated disc.
6. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the membrane to open, allowing flow to pass through the perforations in the disc. When backpressure exceeds the line pressure, the membrane seats on the perforated disc preventing backflow.
7. The valve allows flow out of the reservoir during draw cycles and prevents flow into the reservoir during fill cycles.
8. The elastomer used in construction of the membrane must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."
9. The manufacturer's name, plant location, serial number and product part number which designates membrane size, material and construction specifications shall be bonded onto the surface of the membrane.

C. Carbon Steel Pipe and Fittings

1. Carbon steel pipe and fittings shall conform to the associated standards listed in Section 1.5: Reference Standards.
2. Dimensions for carbon steel fittings shall conform to AWWA C110, unless otherwise specified.
3. Wall thickness for carbon steel pipe and fittings shall be specified by Schedule conforming to ANSI B36.10-1985.
4. Wall thickness and dimensions of carbon steel tubing shall be given in exact dimensions in fractions of an inch, not by gage number.
5. All flanges shall be carbon steel ring flanges conforming to AWWA C207 Class D. Flange drilling pattern shall be in accordance with ANSI B16.1/B16.5 standards.
6. Ring flanges shall be continuously welded on both sides.
7. Welding of carbon steel pipe and fittings shall be in accordance with the Reference standards.
8. All butt welds shall be fully penetrated with gas shielding to the interior and exterior of the joint.
9. Welded cross-sections shall have a thickness equal to or greater than the welded material.
10. Field welding of carbon steel pipe and fittings will not be allowed unless approved by the Engineer.

11. All welded joints shall be free of sharp edges and burrs.
12. Coating of the inside of carbon steel pipe and fittings is not required, unless otherwise specified.
13. Coating of the outside of carbon steel pipe and fittings shall be performed in the field, by the contractor, following installation of the manifold piping system. Surface preparation and coating procedures shall be in accordance with standards listed in Coatings specification.

D. Flange Gaskets

1. Flange gaskets shall be full-faced and shall be in accordance with ASTM D1330.
2. Flange gasket drilling pattern shall conform to ANSI B16.1/B16.5.
3. Flange gaskets shall be 1/8" thick.
4. Gasket material shall be EPDM.

E. Fasteners

1. Hex head bolts and nuts shall be stainless steel 316 conforming to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.
2. Plastic insulating sleeve/washers shall be utilized to isolate dissimilar bolt and flange metals where required.

F. Pipe Supports

1. All components of the bracket assembly shall be stainless steel 304 in accordance with the associated standards.
2. The bracket assemblies shall consist of four components:
 - a. A base plate (when required). For concrete tanks, the base plate will have four thru holes for expansion anchors.
 - b. A top-works weldment that consists of structural channel and angle iron. The HMS piping shall rest on the angle iron. The angle iron has predrilled holes for the U-bolt.
 - c. U-bolt with four hex nuts.
 - d. An 1/8" thick EPDM strip with a length equivalent to the circumference of the pipe. The strip shall be placed between the pipe and the angle iron and U-bolt.
3. The channel of the top-works weldment shall be field fit and modified to the required length. The channel shall then be field welded to the base plate.
4. For steel tanks, the base plate shall be field welded to the tank floor or shell. The location of the base plate shall avoid welded joints in the floor/shell plates.

5. For concrete tanks, the support shall be anchored to the concrete floor with stud type expansion anchors, the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section.
 6. Plastic insulating sleeve/washers shall be utilized to isolate dissimilar metals where required.
- G. Coatings
1. Following installation of the manifold system, all carbon steel and ductile iron pipe, fittings, bolted connections, pipe supports, and appurtenances shall be coated according to the protective coating specification as specified by the Engineer.
 2. Surface preparation and coating procedures shall be provided by the Engineer and the coating supplier.
 3. Tideflex and Waterflex Valves shall not be coated. The valves shall either be masked or be mounted after coating of the tank and piping. Contractor to ensure masking materials are removed after coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of the manifold system shall be in accordance with the installation plans and guidelines provided by the HMS manufacturer and as specified in the installation section of the IOM manual. Refer to section on Submittals for quantities and delivery schedules of the documents.

3.2 INSTALLATION INSPECTION AND START-UP TESTING PROCEDURES

- A. The HMS manufacturer's authorized representative shall provide one (1) day inspection to verify that the system has been installed in accordance with the design specifications and installation drawings.
- B. Start-Up Flow Testing
 1. Following installation of the complete manifold piping system, the Contractor shall open the upstream isolation valve to allow flow into the tank through the manifold system. The isolation valve must be opened slowly to prevent surge or over-pressurization of the manifold system. The isolation valve must be fully opened to inspect the flow characteristics of the manifold system.
 2. The Contractor and factory representative shall visually inspect the entire piping system for leakage.
 3. The Contractor and factory representative shall visually inspect all of the inlet nozzles to ensure flow is being discharged into the tank through all nozzles.

3.3 SPARE PARTS

- A. Spare parts are not required, unless otherwise specified.

****END OF SECTION****

SECTION 11318

PROGRESSIVE CAVITY PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of progressive cavity pumps.

1.2 RELATED WORK

- A. Section 01300: Contractor Submittals
- B. Section 09800: Protective Coating
- C. Section 13427: Water Quality Instruments
- D. Section 260530: General Instrumentation and Control Requirements

1.3 SYSTEM DESCRIPTION

- A. Furnish and install complete operating progressive cavity pump including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary trades and crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pump	Satisfactory operation	Manufacturer's standard bench test	1 each pump	Contractor	Contractor

1.5 REFERENCES

- A. California Building Code (CBC)
- B. California Electrical Code (CEC)
- C. NEMA MG1 Motors and Generators
- D. NEMA/ANSI 250 Enclosures for Electrical Equipment
- E. NFPA 70 National Electric Code

- F. NSF/ANSI 60 Drinking Water Treatment Chemicals – Health Effects
- G. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 SUBMITTALS

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per valve pump and pipeline equipment shop drawing requirements.	
	Required for motors and pump control panels under electrically controlled equipment shop drawing requirements.	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation or application instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements	
Test Record Transcripts	Submit factory certification of pump performance including pumping heads and capacities versus speed.	
Motor Data	Required	
Warranty	Furnish three-year warranty from date of final acceptance	

- B. Refer to Section 01300 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and test record transcripts.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of progressive cavity pumps shall be strictly followed.

1.8 UNIT PRICES

- A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Progressive Cavity Pumps	Monoflo	Houston, TX
	Seepex	Enon, OH
	Accepted equal	
Variable Speed Gear Motor	Emerson Power Transmission "IntelliGear Plus"	Maysville, KY
	Accepted equal	

2.2 MATERIALS

A. Progressive cavity pumps shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Universal Joint Sleeve	EPDM	
Rotor	Titanium	
Seals	Mechanical	

B. The following pump conditions are expected:

PUMP	FLUID PUMPED	PROPERTIES	
Chlorine Analyzer Discharge Pump	Potable Water (33-113°F)	Discharge	8 gal per hour minimum
			10 gal per hour average
			13 gal per hour maximum
		Discharge Pressure	150 psig
		Suction Head	Approx. -3 ft

- To avoid creating a vacuum scenario inside the chlorine analyzer, the progressive cavity pump shall not pump at a rate that exceeds the flow through the suction-side tubing of the chlorine analyzer.
- The pump will be discharging into the suction piping at the Soledad Pump Station. The suction piping has approximately 5-13 psi.

C. The following product design criteria, options and accessories are required for pumps:

ITEM	DESCRIPTION	
Chlorine analyzer injection system pump	Injection Pump	Progressive cavity pump
	Number of Pumps required	1
	Pressure Relief and Backpressure Valve	Provide on chlorine analyzer discharge
	Pump Options	Y strainer
	Stator Lining	Meet NSF 61 for potable water applications
	Pressure Gauge	Required with PVC isolator

D. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION	
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion- Resistant
	Submergence Rating	72-hour 20-feet of head per IP68
Control Panel Mounting	Local Mount	See plans
Power Supply	Motor Circuit	120VAC – 1 phase – 60Hz
	Control Panel	120VAC – 1 phase – 60Hz

E. The following product design criteria, options and accessories are required for pump drives:

ITEM	DESCRIPTION	
Pump motors	Pump Motor	AC motor with AC VFD
	Duty	Continuous Duty
	Temperature Rise	NEMA Design B Rated for Operation at 40°C (104°F)
	Max Drive Power Consumption	135 VA
	Motor and Control Options	Local manual speed control setting Alarm stop Motor overload protection

PART 3 - EXECUTION

3.1 PREPARATION

- A. Make field measurements needed to install progressive cavity pumps before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 INSTALLATION

- A. Furnish and install progressive cavity pumps at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building, fire, plumbing, mechanical and electrical code requirements
- C. Refer variances between the above documents and Contract Documents to Owner's Representative.
- C. Install progressive cavity pumps to tolerances recommended by Manufacturer. Unless
- D. otherwise shown, install progressive cavity pumps true and level using precision gauges and levels.

3.3 FIELD QUALITY CONTROL

- A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Progressive Cavity Pumps	Field Performance and Calibration	See procedure below	1 each pump	Contractor	Contractor
	Installation, Noise, Vibration,	Visual inspection of finished installation	1 inspection	Owner	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Odors, Heat and Leakage				
	Running Amperage	Record amperage draw and compare to rated motor FLC	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed Literature	1 test	Owner	Contractor

B. Upon installation of metering pump, calibrate and test the metering pump as specified below.

1. Temporarily cap discharge of metering pump and provide hose to convey metering pump discharge from flush fittings to containment sump.
2. Obtain at least four pairs of pump rate versus pump speed data to cover pump operating range from its rated capacity to its minimum output. Prior to recording each calibration point, adjust backpressure valve to provide pump with backpressure at pump's rated capacity. Allow pump to stabilize its pumping rate for at least 15 minutes. Pump calibration curve shall then be plotted with points thus obtained. Calibration curve shall demonstrate pump is capable of a turndown ratio of at least 10 to 1 from its rated capacity and that pump performance is within 5 percent of submitted pump characteristic curve. If pump fails to meet these requirements, adjust, repair or replace pump until requirements are met.
3. After calibration, operate metering pump at its maximum, half and minimum pumping rate. Adjust pumping rate using simulated flow inputs to pump controls. Operate pump for 2 continuous hours with each pumping rate. During this 2-hour period, pump shall exhibit no fluctuation of pumping rate, excessive noise or vibration or other signs of distress.

C. Provide services of factory authorized representative on-site for a minimum of two man-days (travel time excluded) to provide the following:

1. Installation assistance, inspection and startup of the complete progressive cavity pump system.
2. Field testing and adjustment.
3. Instruction of Owner's personnel in operation and maintenance.

3.4 SPARE PARTS

A. Furnish the following spare parts:

QUANTITY	PART
1	Progressive cavity pump

****END OF SECTION****

SECTION 13205

MODIFICATIONS TO EXISTING CONCRETE WATER TANK

PART 1 - GENERAL

1.1 Work Included

- A. This section includes materials, testing, and installation of modifications to the existing prestressed concrete Soledad reservoir. The prestressed concrete tank has an existing steel liner on the interior wall and floor. The original tank does not conform to AWWA D110.
- B. The following modifications are being made to the reservoir:
 - a. Installation of a new 16" inlet pipeline
 - b. Installation of a new 16" outlet pipeline
 - c. Installation of a new small diameter copper sensing tube for the altitude valve
 - d. Installation of a Tideflex mixing system on the reservoir floor
 - e. Installation of a chlorine analyzer conduit and tube through tank wall to the center of the reservoir
 - f. Installation of a new external tank gauge
 - g. Installation of a new ultra sonic level sensor

1.2 Related Work

- A. Section 01300: Contractor Submittals
- B. Section 02050: Demolition
- C. Section 03300: Cast-in-Place Structural Concrete
- D. Section 11268: Reservoir Hydrodynamic Mixing System (HMS)
- E. Section 15120: Altitude Valves

1.3 System Description

- A. Furnish and install complete operating modifications to the existing concrete water tank including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Welding procedures and welding operators shall have been qualified in accordance with AWS Standard Qualification Procedures.

1.5 References

- A. AWWA C200 Steel Water Pipe 6 in and Larger
- B. AWWA C651 Disinfection of Water Mains
- C. AWWA C652 Disinfection of Water Storage Facilities
- D. API Standard 653, Tank Inspection, Repair, Alteration and Reconstruction

E. Standard Methods for Examination of Water and Wastewater

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Experience qualifications for prestressed tank penetrations	A list of at least 5 prestressed wall penetrations of the same type and application to include the following information: Name of facility, facility owner, contact name, address, phone number, penetration size, purpose and year of installation.	
Shop Drawings	Required for all tank modifications and all appurtenances per structural shop drawing requirements. Wall footing shoring plans shall also be provided.	
Catalog Data	Required for standard manufactured components including water level indicator per catalog data requirements.	
	Required for all joint fillers and sealants	
Engineering Calculations	Required for tank shell penetrations, to be performed by contractor responsible for prestressed concrete wall penetrations per the requirements in Paragraph 1.7.A. Penetrations to be designed to match existing design capacity and shall not to be updated per current design codes.	
Welder Qualification Certificates	Required per AWWA D100 Section 11.3	
Field Inspection of Welds Written Report	Submit for field weld inspection per requirements of AWWA D100 Section 11.2.1	
Installation Instructions	Required for appurtenances per installation instruction requirements.	
O & M Instructions	Required for appurtenances per operation and maintenance instruction requirements.	
Warranty	Furnish 3-year warranty from date of final acceptance	

B. Refer to Section 01300 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, engineering calculations and test record transcripts.

1.7 Qualifications Requirement

A. Contractor responsible for design and installation of penetrations must be experienced in the design and construction of AWWA D110 prestressed concrete tanks. Contractors shall have completed prestressed concrete tank penetrations of the same type for at least 5 years. At least 1 penetration installation of the same size or larger as proposed for the project and shall have been completed within the last 5 years.

1.8 Delivery, Storage and Handling

A. Refer to Section 01300 for delivery storage and handling requirements.

1.9 Unit Prices

A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Acceptable manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Polyurethane Sealant	C&M Industries	
	Approved equal	
Tank Level Gauge	CB&I	San Luis Obispo, CA
	Approved equal	

2.2 Materials

A. Refer to Section 01300 for basic requirements for products and materials.

B. Water Tank Modifications shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Sealant	Polyurethane	High solids 2 component liquid cold-applied chemical resistant asphalt-extended urethane elastomer that cures to a durable abrasion-resistant film
Inlet/Outlet connections)	Steel Pipe - above ground	AWWA C200
	Pipe and Nozzle Lining - cement mortar lining	AWWA C205
	Pipe Coating – Inside Tank	Match interior tank coating
	Pipe Coating – Outside Tank, Cement Mortar	AWWA C205

C. The following tank options and modifications to appurtenances are required:

ITEM	DESCRIPTION
Appurtenance Design Criteria	Design reinforcement around openings per structural drawings.
Water Level Indicator	Sliding vertical target with aluminum guides and aluminum scale board. Graduate scale to read one foot for each foot difference in water level. Moving parts shall be noncorrosive. Materials inside tank shall be stainless steel.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install Modifications to Existing Water Tanks and appurtenances before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Fabricate and install modifications to water tank in accordance with the requirements of AWWA D110 and API 653. Provide weld inspection as required by AWWA D100 and furnish documentation as needed to support Written Field Inspection Report per AWWA D100 Section 11.2.1
- B. Before making coating repairs to steel liner, remove all sharp structural steel edges, burrs and all weld spatter and rough welded seams. Grind sharp edges smooth to satisfaction of Owner's Representative.

3.3 Disinfection

- A. Disinfection shall be accomplished after all applied coatings have completely cured and after cleaning has occurred.
- B. If volatile organic or coliform bacteria levels exceed those allowed by the State of California, Department of Health Services, drain tank contents to waste and refill at Contractor's expense (including water.) Tank shall be soaked and retested for coliform bacteria and volatile organics until satisfactory test results are achieved. The cost of all remedial measures to pass coliform or volatile organic tests shall be the responsibility of the Contractor.

- C. Disinfection shall include the following:

ITEM	DESCRIPTION
Tank	Disinfect per AWWA C652 Chlorination Method 2.
Tank Piping	Disinfect per AWWA C651 and Owner requirements

3.4 Field Quality Control

- A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Welding	Absence of sharp edges, weld spatters and burrs	Visual inspection by Owner's Representative	As directed	Owner	Owner
	Spot tests of welded joints	Cutting and testing sectional segments per AWWA D100 Section 11.8 or radiographic testing per AWWA D100 Section 11.6 at Contractor's option	As described in AWWA D100 Section 11.5	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Leakage in Tank Bottom Welded Joints	AWWA D100 Section 11.11 (Vacuum Method)	1 inspection	Contractor	Contractor
Tank	Field Performance	Demonstrate compliance to Contract Documents and Manufacturers' printed Literature	1 test	Contractor	Contractor
	Disinfection	AWWA C652 Section 4.4	As required by Standard Methods for Examination of Water and Wastewater	Contractor	Contractor
Tank Piping	Disinfection	AWWA C651 Section 5	2 sets of samples 24 hours apart	Contractor	Contractor
All Work	11 month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturers printed Literature	1 test	Owner	Contractor

****END OF SECTION****

SECTION 13427

WATER QUALITY INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of water quality instruments.

1.2 RELATED WORK

- A. Section 01300: Contractor Submittals
- B. Section 11318: Progressive Cavity Pumps

1.3 SYSTEM DESCRIPTION

- A. Furnish and install complete operating water quality instruments including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building and electrical codes and standards.
- B. Chlorine Analyzer System shall be capable to measure both total and free chlorine.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary trades and crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Water Quality Instruments	NRTL Certification	UL and CSA standards	1 each instrument type	Contractor	Contractor

1.5 REFERENCES

- A. California Plumbing Code (CPC)
- B. NSF/ANSI 61 Drinking Water Standards Health Effects
- C. NEMA/ANSI 250 Enclosures for Electrical Equipment
- D. NFPA 70 National Electric Code

1.6 SUBMITTALS

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for water quality instruments under electrically controlled equipment	.
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation or application instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements	
Certificate of Compliance	Submit affidavit of NRTL certification to UL and CSA standards on request.	
Warranty	Furnish 3-year warranty from date of final acceptance	

- B. Refer to Section 01300 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and certificates of compliance.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of water quality instruments shall be strictly followed.

1.8 UNIT PRICES

- A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Chlorine Analyzer System (Reagentless Amperometric)	Hach - CLF10 (Free Chlorine) & CLT10 (Total Chlorine) sensors with dual input sc200 Controller	Loveland, CO
	ProMinent - CLE (Free Chlorine) & CTE (Total Chlorine) sensors with D2C Controller	Pittsburgh, PA
	Accepted Equal	

- B. Water quality indicators, recorders and transmitters where shown shall be manufactured by same Manufacturer as flow sensing equipment and shall be fully compatible with equipment furnished.

2.2 MATERIALS

- A. Sensors shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body	Stainless Steel	SAE Type 316
Wetted Material	Stainless Steel	As recommended by manufacturer for use with chlorinated water
	Polypropylene	
	PVDF	
	Teflon	

- B. The following product design criteria, options and accessories are required for chlorine analyzers:

ITEM	DESCRIPTION	
Chlorine Analyzer	Quantity	1 free residual analyzer and 1 total residual analyzer Both the Free and Total residual analyzer shall be connected to a single controller
	Type	Reagentless type
	Controller	Dual input (for Free and Total Chlorine)
	Fluid Sampled	Potable Water
	Sample Temperature	33°F – 113°F
	Required flow through Analyzer	8-13 gal/hr (30-50 L/hr)
	Sample Pressure	0.5 – 8 psi
	Sample pH	5 – 9
	Lower Detection Limit	0.035 ppm
	Range	0.035-10 ppm free chlorine 0.035-10 ppm total chlorine
	Accuracy	±10.0% of reading
	Response Time	T ₉₀ < 2.5 minutes
	Analog Output	Two 4-20mA signals
	Digital Output	Two SPDT relays
	Mounting	Panel-mount
Supply Voltage Available	120VAC – 1 phase - 60Hz	

1. The complete analyzer system (free chlorine sensor, total chlorine sensor, and dual input controller) shall be located inside a single panel.
2. The analyzer shall discharge back into the potable water system via a progressive cavity sample pump (see Section 11318). A check valve shall be installed downstream of the sample pump do prevent backflow entering the analyzer per the Plans.
3. Upstream and downstream pressures on the Chlorine analyzer shall not exceed 8 psi.

- C. The following electrical design criteria are required for equipment in this section:

ITEM	DESCRIPTION	
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant
Indicator Mounting	Local Mount	Surface-mount on wall
Power Supply		120VAC – 1 phase – 60Hz

PART 3 - EXECUTION

3.1 PREPARATION

- A. Make field measurements needed to install water quality instruments before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 INSTALLATION

- A. Furnish and install water quality instruments at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulation
 - 3. Applicable building, fire, plumbing and electrical code requirements
- C. Refer variances between the above documents and Contract Documents to Owner's Representative.
- D. Install water quality instruments to tolerances recommended by Manufacturer. Unless otherwise shown, install water quality instruments true and level using precision gauges and levels.

3.3 FIELD QUALITY CONTROL

- A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Water Quality Instruments	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

3.4 ADJUSTING AND CLEANING

- A. Provide services of Manufacturer's representative as needed for startup, inspection and necessary adjustments as needed to integrate new water quality instrumentation into existing telemetry network.

3.5 SPARE PARTS

- A. Furnish the following spare parts:

QUANTITY	PART
1	Any membrane or electrolyte requiring replacement in first year operation

****END OF SECTION****

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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 Peerless pumps, and therefore may not be 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 reservoir is half full) and at minimum head (when reservoir is 90% full) at a specified pressure of approximately 100 psi. The City normal operating conditions are between half full reservoir and 90% full reservoir per City requirements. In addition, all pumps shall be able to operate at approximately 70% and 120% or greater 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 an alternative control scheme providing that the pumps will be operating, as indicated in paragraph 1.1.C. CONTRACTOR shall provide at least 1 reference where similar pumping units were successfully implemented and operational for a 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. 11214 Vertical Turbine Pumps

1.3 SYSTEM DESCRIPTION.

- A. Proposed Soledad PS will have two-variable speed (V/S) pumps (430 gpm design capacity, Pumps P-1 and P-2) and two-constant speed fire pumps (880 gpm design capacity, Pumps P-3 and P-4).
- 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 approximately 100 psi.
- 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 1150 rpm for pumps P-1 and P-2 but shall be field adjusted for proper pump operation.

- D. Due to the relatively flat system curve, there will be significant change in flows with very little increase in system head. Field adjustments will be necessary to find the correct operating points for each pump.

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 the instrumentation plan sheets and as specified herein.

3.1 SURGE TANK OPERATION

The surge tank will provide system flows from 0 gpm to 38 gpm.

3.2 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS INCREASE FROM 38 GPM UP TO 850 GPM (NO FIRE FLOW)

The pump control sequence is performed by the PLC with programmed software logic and adjustable software timers. Discharge manifold pressure (100 psi) would be the sensed control.

(38 gpm to 430 gpm): As the pressure set point for pump operation is reached, the first pump P1 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 (1770 rpm).

(430 gpm to 850 gpm): With P-1 running at the maximum speed of 1770 rpm, when the pressure in the discharge manifold drops 5 psi below set pressure (100 psi) for a preset time period (initial set @30 seconds), the PLC starts pump P2 at minimum set speed of 1150 rpm and ramps to maintain discharge pressure at the set pressure value. Both jockey pumps shall run at similar speeds to maintain constant setpoint pressure.

If the flow demands continue to increase, P2 will reach its maximum rpm and with P1 working also at max rpm, the total pumping capacity will be approx 850 gpm.

3.3 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS DECREASE FROM 850 GPM TO 38 GPM

With pumps P1 and P2 operational, when flow demand decreases P2 will decrease its rpm to the minimum.

With flow demand decreasing, with both P1 and P2 operating at minimum set speed for the preset period of time (initially set @ 30 seconds), pump P2 will be called OFF, pump P1 will continue to run and ramp to a speed to achieve setpoint pressure.

With P1 operational, when flow demand further decreases, P1 will decrease its rpm to the minimum. Once flows go below P1's minimum flow (38 gpm), Pump P1 will turn off and the demand will be supplied by the hydro pneumatic/surge tank

The constant speed pumps P3 and P4 remain non-operational.

3.4 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS INCREASE BETWEEN 850 GPM UP TO 1260 GPM (NO FIRE FLOW)

With pumps P1 and P2 running at the maximum speed of 1770 rpm, when the pressure in the discharge manifold drops 5 psi below set pressure (100 psi) for a preset time period (initial set @30 seconds), the PLC starts pump P3. P3 will run for a preset time period (initial set @ 30 seconds) and is capable of providing 880 gpm. P2 will switch off. P1 will remain in operation and RPMs will adjust accordingly to provide flow rates in combination with P3 up to 1,260 gpm.

3.5 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS DECREASE FROM 1260 GPM TO 850 GPM (NO FIRE FLOW)

Reverse the sequence described in section 3.4 above.

3.6 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS INCREASE BETWEEN 1260 GPM UP TO 1675 GPM

With P1 and P3 operating at maximum RPM and when the pressure in the discharge manifold drops 5 psi below set pressure (100 psi) for a preset time period (initial set @30 seconds), the PLC starts pump P2 at a minimum speed of 1150 RPM which ramps up to maximum speed of 1770 RPM until 1675 gpm is reached.

3.7 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS DECREASE FROM 1675 GPM TO 1260 GPM (NO FIRE FLOW)

Reverse the sequence described in section 3.6 above.

3.8 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS INCREASE BETWEEN 1675 GPM UP TO 2050 GPM

(1675 gpm) With pumps P1, P2 and P3 operating at maximum RPM and when the pressure in the discharge manifold drops 5 psi below set pressure (100 psi) for a preset time period (initial set @30 seconds), the PLC starts pump P4 while ramping down pumps P2 and P1 to minimum RPM and switching off. Pumps P3 and P4 operating together should produce 1675 gpm.

(1675 gpm to 2050 gpm) With pumps P3 and P4 operating and when the pressure in the discharge manifold drops 5 psi below set pressure (100 psi) for a preset time period (initial set @ 30 seconds), the PLC starts pump P1 at a minimum speed of 1150 RPM which ramps up to maximum speed of 1770 RPM until 2050 gpm is reached.

3.9 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS DECREASE FROM 2050 GPM TO 1675 GPM

Reverse the sequence described in section 3.8 above.

3.10 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS INCREASE FROM 2050 GPM TO 2480 GPM (FIRE FLOW)

With pump P1 operating at maximum speed and pumps P3 and P4 operating and when the pressure in the discharge manifold drops 5 psi below set pressure (100 psi) for a preset time period (initial set @ 30 seconds), the PLC starts pump P2 at a

minimum speed of 1150 RPM. P2 speed ramps up to a maximum speed of 1770 RPM at which points all 4 pumps are operating and providing flows up to 2480 GPM.

3.11 SEQUENCE OF OPERATION WHEN THE FLOW DEMANDS DECREASE FROM 2480 TO 2050 GPM

Reverse the sequence described in section 3.10 above.

3.12 PUMP ALTERNATION

- A. Domestic Demand Pumps P1 and P2, and Fire Pumps P3 and P4 shall alternate based on elapsed run time.

3.13 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. Pump/valve P-1 failure
 7. Pump/valve P-2 failure
 8. Pump/valve P-3 failure
 9. Pump/valve P-4 failure
 10. Pump/valve P-5 failure (Sump pump)
 11. 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 14630 Electric Bridge Crane Systems
- 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 05500 Miscellaneous Metalwork
 - 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:
 1. Shop drawings indicating electrical requirements, weights, loads, dimensions and clearances.

1.5 OWNER'S MANUAL

- A. In addition to the requirements of Section 11000, the following shall be submitted in compliance with Section 01300:
 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 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 Inc.

CES Material Handling

ACCO Material Handling Solutions

TC American Monorail

Gorbel

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, 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 14630

ELECTRIC BRIDGE CRANE SYSTEMS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing an electrically operated bridge crane of the low headroom type, designed for travel in both directions and mounted on structural sections.

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 14600 Hoists and Cranes, General

1.3 SERVICES OF MANUFACTURER

- A. Services of manufacturer shall comply with Section 14600. The authorized manufacturer's representative shall visit the site for not less than 1 day.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Requirement: The bridge crane system shall be controlled from a pendant pushbutton station and shall include safety devices and overload protection. The power supply shall be from enclosed, UL-approved conductor bar systems. The rails shall be standard I-beams, or fabricated steel sections anchored to the structure as indicated and as required by the UBC for seismic loads. The track deflection shall not exceed 1/800 of the span, or 1-1/4 inches, whichever is less. The crane system, except the tracks, shall be the product of a crane manufacturer regularly engaged in the manufacture of such equipment.

- B. Site Conditions: The bridge crane shall comply with the following:

Location - Soledad Pump Station Building

Atmosphere - Indoor use

- C. Design Criteria: The bridge crane system shall comply with the following:

Type of Crane - underhung

Type of Bridge - single girder

Capacity (tons) - 2

Speed Control - Single Speed

Power Supply (V-ph-Hz) - 480-3-60

2.2 FABRICATION

- A. Hook and Wire Rope: The lifting hook shall be fabricated of drop-forged, heat-treated steel and shall include 360-degree swivel on a shielded roller thrust bearing with safety spring latch. The wire ropes shall be fabricated of plow steel with steel center complete and shall include swaged fittings.
- B. Hoist and Drive: The hoisting drum shall be deep grooved flanged drum with at least 2 full turns of rope remaining on the drum at the lowest hook position and shall include heavy-duty pre-lubricated sealed bearings. The drum shall be driven by a helical gear reducer with external spur drum gear enclosed in an oil-tight housing. The housing motor shall be a standard, 30-minute duty-motor, 1750 rpm, with NEMA-type shaft extension. The hoisting mechanism shall include dc magnet-actuated disc motor brake with hook drift. The motor shall be rated at minimum of 150 percent of full load torque, with gravity type upper and lower hook limit switch, and an overload cut-off switch designed to interrupt the raising circuit.
- C. Trolley Assembly: The trolley assembly shall be a underhung type. The trolley assembly shall be supported by trolley wheels with tapered tread surfaces hardened to 375 to 425 Brinell. Each wheel shall be supported on tapered roller bearings suitable to take radial and thrust loads. The wheel mounting shall be designed so that axles and wheels can be removed without affecting alignment. The wheel tread shall be smooth, true, and uniform within 0.010-inch tread diameter on all wheels.
- D. Trolley Drive: The trolley shall be driven by a 30-minute-duty-cycle rated motor with oil-tight gear reducer conforming to NEMA Specifications. The motor shall include cushion start and controller designed for smooth travel and load control. The driver shall provide synchronous drive from gear reducer to both drive wheels. The trolley drive shall include integrally mounted spring set and an electrically-released drag brake.
- E. Crane Bridge Assembly: The bridge beam shall be designed in accordance with the specifications of the Crane Manufacturers Association of America. It shall be fabricated of standard structural shapes complying with AISC Specifications. At full load, the beam shall be designed to limit the deflection to 1/600 of the span, but not to exceed 1-1/4-inch maximum deflection. An ASCE rail shall be provided on top of the beam securely fastened in place to maintain center distance. Provision shall be made to prevent creeping of bridge rails by means of positive stops at the ends of the rails. Crane shall be reinforced with outrigger to provide squareness with end truck, adequate lateral stiffness with a minimum lateral moment of inertia of 1/20 that of the vertical beam. Outrigger shall be designed to support squaring shaft and the crane drive motor and gear reducer assembly.
- F. End Trucks: The end trucks shall be traversed by stable assembly of structural shapes welded together to provide proper wheel and bearing alignment. The end truck wheel base shall be minimum of 1/7 of the crane span. One wheel of each end truck shall be geared and meshed with the pinion mounted on the crane squaring shaft. The crane and trucks shall contain diaphragm members welded to truck frames to maintain alignment and distribute truck loads on inner and outer truck members. The truck shall be designed so that, in case of a wheel axle or wheel failure, the drop of the load will be limited to one inch. The end trucks shall be fastened to the bridge beams with bolts to ensure alignment.
- G. Crane Wheels: Crane wheels shall have tread surfaces hardened to 375 to 425 Brinell. Treads shall be tapered to provide proper running alignment. Each wheel shall be supported on tapered roller bearings mounted on stationary axles, designed for radial and thrust loads. The wheels shall be lubricated at the factory with a sodium base grease, and shall include adequate reservoir of lubricant to eliminate the need for field lubrication. Wheel axles must have mounting nuts for bearing adjustment. Wheel mounting shall be designed so that axles and wheels can be

removed without disturbing alignment. Wheel treads shall be smooth, true, and uniform within 0.01-inch tread diameter on all wheels.

- H. Crane Drive: The crane drive motor shall be totally enclosed, 30-minute cycle rated. The motor shall be integral with a fully enclosed oil splash lubricated gear reduction. The motor, the drive shaft, and the gear reduction shafts shall be supported by permanently lubricated precision ball or roller bearings. The drive shaft shall provide synchronous drive from the gear reduction to both end trucks. The crane drive shall include integrally-mounted spring set electrically released dc rectified disc brake.
- I. Drive Shaft: The drive shaft of the crane shall be supported on lubricated, precision, ball-bearing pillow blocks on 10-ft maximum centers. Pillow blocks shall be lubricated through pressure grease fittings. The crane drive shaft shall be steel and designed to limit torsional shaft stress to 6,000 psi. Maximum torsional twist angle in the drive shaft shall not exceed one degree of the wheel rotation under maximum rated load.
- J. Bearing Life: Bearings in crane wheels and bearings supporting the drive and gear reduction shafts shall be designed for 5,000 hrs L-10 bearing life minimum.
- K. Gearing: Gears shall be cut from solid blanks with 20-degree pressure angle involute shape for high strength and shall comply with AGMA specifications for load ratings. Gears operating at higher than 20 fpm pitch line speed shall be fully enclosed in oil-tight housings and lubricated by splash principle. Gear teeth shall have ductile cores and be surface hardened to RC40 minimum. The gear shall provide for a minimum service of 4,000 hr.
- L. Bridge Stops: The bridge shall be provided with bumpers capable of stopping the crane (not including the lifted load) at a rate of deceleration not to exceed 3 fps when traveling in either direction at 20 percent of rated speed. The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40 percent of the rated load speed. Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the crane wheel.
- M. Runway Beams and Rails: The runway beams and rails shall comply with the indicated requirements. The rails shall be an ASCE type securely fastened into the runway beams. The runway beams shall be designed from an ASTM A36 structural steel shape and shall have a maximum deflection not to exceed 1/800 of the span. The beams shall be equipped with stops on both ends capable of withstanding the impact of the fully loaded crane at 50 percent of rated speed, and shall be field-adjustable. Necessary column supports or clamps, hanger rods, bolts, and fittings shall be provided.
- N. Electrical Controls: Electrical controls shall be single-speed or multiple-speed as recommended by the manufacturer. Bridge control shall include a mainline magnetic contactor, manually-operated fused mainline disconnect with lock-out provisions, branch circuit fuses, reversing bridge control, and transformer with fused secondary. Bridge control shall be mounted on bridge in an enclosure, NEMA rated in accordance with the area designations of Section 16050, actuated from a pendant pushbutton station suspended from movable trolley, by means of a retractable cable to permit operation at 4 feet above all floor levels. Motors shall include cushion start.
- O. Conductor and Wirings: The runway shall be provided with enclosed conductor base electrification. The bridge shall have a rigid truck festoon type electrification. Other wiring of the crane shall be in rigid or flexible conduit and in accordance with National Electrical Code and complying with Fire Underwriters specifications. When a crane is shipped knocked down, the wiring shall terminate in terminal boxes and the wire end shall be provided with permanent marking tags.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Bridge cranes shall be installed in accordance with Section 14600 and per the manufacturer's requirements.

****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

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. International Mechanical Code
 - 2. International Plumbing Code
 - 3. International 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 Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 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 as follows:

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 OWNER'S MANUAL

A. The following shall be included in the OWNER'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. Inspection: All pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the date for the start of each phase of pipe production and the dates for the proof of design tests. The notification shall be given at least 14 days prior to the start of the pipe manufacture. During the manufacture of the pipe, the CONSTRUCTION MANAGER shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

B. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The CONTRACTOR shall perform all tests at no additional cost to the OWNER. Copies of all test reports shall be furnished to the CONSTRUCTION MANAGER.

C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.

Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing Work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders at no increased cost to the OWNER.

1.8 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable in order to obtain perfect pipe joints, supports, or special connections, the CONTRACTOR shall furnish such assistance at no additional cost to the OWNER.

1.9 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.
- B. **Pipe Supports:** Pipes shall be properly supported in accordance with Section 15020.
- C. **Coating:** Pipes above ground or in structures shall be field-painted in accordance with Section 09800.
- 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. 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 Flange Sets:** See Section 16640.
- F. **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.

G. Flange Gasket Manufacturers, or Equal

1. John Crane, Style 2160
2. Garlock, Style 3000

H. Flanged Coupling Adapter: Flanged coupling adapters shall have carbon steel or ductile iron flanged body meeting AWWA C207 and C219. Gaskets shall be Sryrene Butadiene Rubber (SBR) compounded for water and sewer service. Flange gasket is an O-ring style made of Nitrile Butadiene Rubber (NBR) in accordance with ASTM D2000 MBK.

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. See Section 16640.
- 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 (FLEXIBLE) COUPLINGS

- A. **Construction:** Sleeve-type couplings (also referred to as flexible couplings) shall be provided where indicated on the Drawings, in accordance with ANSI/AWWA C219 unless otherwise indicated on the Drawings, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7-inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30 inches, for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts for couplings shall be Type 316 stainless steel. Sleeve-type couplings shall be fusion bonded epoxy lined and coated at the factory in accordance with AWWA C213. Buried couplings 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, stud materials and nuts shall be stainless steel per the manufacturer's requirements. 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 120 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.

F. **Manufacturers or Equal:**

1. Dresser, Style 38
2. Ford Meter Box Co., Inc., Style FC1 or FC3
3. Smith-Blair, Style 411
4. Romac, Style 501

2.5 EQUIPMENT CONNECTION COUPLINGS

A. Equipment connection couplings shall be provided in all piping connections to engines, blowers, compressors, vibrating equipment, and where indicated. Couplings shall be 316 stainless steel. All nuts, bolts and washers shall be 316 stainless steel. 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, 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. See section 15118

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 as recommended by the manufacturer.

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.

2.10 PIPE WALL SLEEVE

- A. Pipe penetration through walls shall be made utilizing a modular elastomer sealing system that creates a hydrostatic watertight seal. Modular seals shall be linking, shall be made of EPDM with reinforced nylon polymer pressure plates. All hardware shall be 316 stainless steel. Sealing system shall be Link Seal by GPT Industries or approved equal.

2.11 CORPORATION STOPS

- A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with threaded ends with PVC, copper tubing or iron pipe thread, as required. Threads shall comply with the latest edition of AWWA C-800.
- B. Manufacturers: As listed in the latest edition of the City's Approved Materials List.

2.12 TRANSITION COUPLINGS

- A. Transition couplings shall be sleeve type couplings per Section 2.4 above specifically designed for joining different pipe materials and different pipe outside diameters.

2.13 RESTRAINED MECHANICAL JOINTS

- A. Restrained mechanical joints for connecting to PVC pipe shall be EBAA Iron Megalug Mechanical Joint Restraint Series 2000PV or approved equal.

- B. Restrained mechanical joints for connecting to ductile iron or steel pipe shall be EBAA Iron Megalug Mechanical Joint Restraint Series 1100 or approved equal.

2.14 HARNESS LUG TYPE THRUST RESTRAINT

- A. Harness lug type thrust restraint shall have lugs made of ASTM A36 steel with type 316 stainless steel tie rods. System shall be Romac Style 490 or approved equal.

2.15 FLOOR DRAIN SYSTEM

- A. Grated floor drain shall be commercial grade with cast iron body and grate. Piping shall be schedule 40 PVC, minimum. Drainage system materials and installation shall be in accordance with the latest Plumbing Code.

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 and manufacturer's recommendations. The lining manufacturer shall take full responsibility for the complete, final product and its application.
- 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 Teflon tubing, small steel pipe, stainless steel 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
 - 2. Section 15065 Stainless Steel Pipe

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 in compliance with Section 01300:
 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 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.
- 2.3 TEFLON TUBING
- A. Teflon tubing shall conform to the requirements of ASTM D1710-08. Fittings shall be teflon with compression ends or MPT.
- 2.4 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. Use Type K or type L copper is suitable for above ground installations. Use Type K for any buried applications. Type M or Type DWV copper are not to be used at any time.
- 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. Type M or Type DWV copper are not to be used at any time.
- 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.

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 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 as needed or 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 16640 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, clamps, straps 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 01300 and Section 15000 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 inches	Max. Span (@ 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
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	49	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 316 stainless steel 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 designed 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.

2.3 PIPE STRAPS

- A. **COPPER PIPE:** For copper pipe, use bronze or copper coated pipe straps.
- B. **OTHER PIPE MATERIALS:** Use carbon steel, 2 hole, hot-dip galvanized pipe straps except with stainless steel pipe where type 316 stainless steel straps are to be used.

2.4 PIPE CLAMPS

Pipe clamps for the 16" suction piping shall be a galvanized carbon steel restraint type hold down. The clamp radius and base will be lined with PTFE, 25% glass filled, slide plate allowing axial movement while restraining lateral movement. The assembly shall come equipped as a complete unit with all anchor bolt hardware for mounting in concrete.

2.5 MANUFACTURERS

- A. Pipe supports shall be manufactured by one of the following (or equal):

Anvil International

Piping Technology & Products, Inc.

Pipe Supports group

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **General:** Pipe supports, hangers, brackets, anchors, guides, clamps, straps 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 in compliance with Section 01300:
 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., "DHWB-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."

<u>Fluid Abbreviation</u>	<u>Function & Identification</u>	<u>Identification Color</u>	<u>Remarks Suggested Tnemec Color or Equal</u>
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

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 in compliance with Section 01300:
 - 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. Kinetics Noise Control
 - 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****

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SECTION 15065

STAINLESS STEEL PIPE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of stainless steel pipe.
- B. Do not use Type 304 stainless steel pipe for buried applications.

1.2 RELATED WORK

- A. Section 01300: Contractor Submittals
- B. Section 02200: Earthwork
- C. Section 09800: Protective Coating
- D. Section 15116: Stainless Steel Valves, 3-inches and Smaller
- E. Section 15175: Hydropneumatic Surge Control System

1.3 SYSTEM DESCRIPTION

- A. Furnish and install pipe system as shown including appurtenant fittings and connections in conformance with Manufacturer's installation requirements and in compliance with applicable construction safety codes and standards.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 REFERENCES

- A. ASME/ANSI A112.3.1 Performance Standard and Installation Procedures for Stainless Steel Drainage Systems for Sanitary, Storm and Chemical Applications Above and Below Ground
- B. ASME/ANSI B1.20.1 Pipe Threads, General Purpose (inch)
- C. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- D. ASME/ANSI B16.9 Factory-Made Wrought Steel Butt-Welding Fittings
- E. ASME/ANSI B16.11 Forged Steel Fittings, Socket-Welded and Threaded
- F. ASME/ANSI B 31.1 Power Piping
- G. ASME/ANSI B36.19 Stainless Steel Pipe
- H. ASME Boiler and Pressure Vessel Code

- I. ASTM A269 Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- J. ASTM A312 Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- K. ASTM A380 Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- L. ASTM A403 Wrought Austenitic Stainless Steel Pipe Fittings
- M. ASTM A409 Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
- N. ASTM A778 Welded Unannealed Austenitic Stainless Steel Tubular Products
- O. AWWA C206 Field Welding of Steel Water Pipe
- P. AWWA C207 Steel Pipe Flanges
- Q. AWWA C220 Stainless Steel Pipe ½-inch and Larger
- R. AWWA C223 Tapping Sleeves
- S. AWWA C226 Stainless Steel Fittings for Waterworks Service, Sizes ½-inch through 72 inches
- T. AWWA C228 Stainless Steel Pipe Flanges for Water Service, Sizes 2-inch through 72 inches
- U. AWWA C604 Installation of Steel Water Pipe 4 in and Larger
- V. AWWA C606 Grooved and Shouldered Joints
- W. AWWA D100 Welded Steel Tanks for Water Storage
- X. AWWA M11 Steel Water Pipe: A Guide for Design and Installation
- Y. AWS A5.4 Stainless Steel Electrodes for Shielded Metal Arc Welding
- Z. AWS A5.9 Bare Stainless Steel Welding Electrodes and Rods
- AA. AWS B2.1 Welding Procedure and Performance Qualification
- BB. AWS D1.1 Structural Welding Code – Steel
- CC. California Plumbing Code
- DD. Standards for Stainless Steel Pressure Pipe Materials

1.6 SUBMITTALS

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per piping shop drawing requirements.	.
Catalog Data	Required per catalog data requirements for pipe and welding rod for field welding.	
Installation Instructions	Required per installation or application instruction requirements.	
Certificate of Compliance	Submit certification per certificate of compliance requirements.	
Foundry or Test Record Transcripts	Submit mill reports and plant test reports per test record transcript requirements.	
Welder Qualification Certificates	Required per standard qualification procedure of ASME Boiler and Pressure Vessel Code Section IX, Welding Qualifications	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01300 for definition of requirements for shop drawings, catalog data, installation instructions, certificates of compliance, and foundry or test record transcripts.

1.7 DELIVERY, STORAGE AND HANDLING

A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of stainless steel pipe shall be strictly followed.

1.8 UNIT PRICES

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Stainless Steel Pipe 10-inch and Smaller	Cal Pipe Industries	Downey, CA
	Roscoe Moss	Los Angeles, CA
	Western Waterworks Supply	Nampa, ID
	Accepted equal	
Stainless Steel Pipe 12-inch and larger	Ameron	Rancho Cucamonga, CA
	Northwest Pipe	Adelanto, CA
	Accepted equal	
Stainless Steel Fittings and Couplings	JCM Industries	Nash, TX
	Smith-Blair, Inc.	Texarkana, TX
	Victaulic Company	Easton, PA
	Accepted equal	

2.2 MATERIALS

A. Stainless Steel Pipe and Fittings shall comply with AWWA C220 and AWWA C226.

C. Stainless steel pipe shall meet or exceed the following materials and manufacturing requirements:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Pipe 10-inch and smaller	Standards	ASTM A312
	Material	Stainless Steel SAE Type 316L Seamless
	Size	As shown on plans.
	Wall Thickness	<p>Where thickness is not shown on plans, compute thickness to withstand test pressure using Barlow Formula ($t = Pd/2S$) where:</p> <p>P = Design pressure, in psi plus 50 psi minimum</p> <p>S = Steel stress at design pressure, i.e., 16,500 psi</p> <p>t = Steel cylinder thickness, in inches</p> <p>d = OD of steel cylinder, in inches</p> <p>Notwithstanding the above formula, no pipe 4-inch and larger outside buildings and vaults shall have a wall thickness thinner than 10-gauge.</p> <p>Notwithstanding the above formula, no pipe 4-inch and larger inside buildings and vaults shall have wall thickness thinner 3/8-inch.</p> <p>Notwithstanding the above formula, no pipe 3 inches and smaller shall have wall thickness thinner than Schedule 80.</p>
Pipe 12-inch and larger	Standards	ASTM A409 or ASTM A778
	Material	Stainless Steel SAE Type 316L
	Size	As shown on plans.
	Wall Thickness	<p>Where thickness is not shown on plans, compute thickness to withstand test pressure using Barlow Formula ($t = Pd/2S$) where:</p> <p>P = Design pressure, in psi plus 50 psi minimum</p> <p>S = Steel stress at design pressure, i.e., 16,500 psi</p> <p>t = Steel cylinder thickness, in inches</p> <p>d = OD of steel cylinder, in inches</p> <p>Notwithstanding the above formula, no pipe 12-inch and larger outside buildings and vaults shall have wall thickness thinner than 10-gauge.</p> <p>Notwithstanding the above formula, no pipe 12-inch and larger inside buildings and vaults shall have wall thickness thinner 3/8-inch.</p>
Stainless Steel Fittings	Threaded Fittings	ANSI/ASME B16.11 – Forged Fittings, Socket-Welding and Threaded, SAE Type 316L.

	Socket-welding Fittings	Forged stainless steel fittings conforming to ANSI/ASME B16.11, SAE Type 316L.
	Butt welding Fittings	Wrought stainless steel butt-welding fittings conforming to ASTM A403 - Specification for Wrought Austenitic Stainless Steel Piping Fittings, and ANSI/ASME B16.9 – Factory-Made Wrought Steel Butt-Welding Fittings, SAE Type 316.
	Grooved Fittings	Wrought stainless steel grooved fittings conforming to ASTM A403 and ANSI/ASME B16.9, with grooving conforming to AWWA C606, SAE Type 316.
	Flanged Fittings	SAE Type 316L stainless steel flanged fittings and flanges conforming to ANSI/ASME B 16.5 – Pipe Flanges and Flanged Fittings.
Joints	Joints 2-1/2-inch and smaller	Screwed fittings with NPT threads made up with Teflon tape
	Joints 3 inch and larger	Flanged except where shown as plain-end, grooved or shouldered. Do not groove any pipe less than Schedule 40
Flanges	Stainless Steel	Comply with AWWA C228
Flange Dimensions	Pressures 0-150 psi	AWWA C207 Class D, or ANSI /ASME 16.5 Class 150
	Pressures 150-250 psi	AWWA C207 Class E, or ANSI /ASME 16.5 Class 150
	Alignment for Valve Mating	Boltholes of flanged valves shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, Washers and Gaskets		Per specifications

PART 3 - EXECUTION

3.1 PREPARATION

- A. Make field measurements needed to install stainless steel pipe before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Carefully inspect each pipe length prior to installation. Flush each length clean of debris or dust, and straighten if not true. Ream ends of threaded pipes and file smooth. Clean all pipe fittings before assembly.

3.2 INSTALLATION

- A. Furnish and install pipe and fittings at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements

2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building, fire, plumbing and mechanical code requirements
 4. ASME/ANSI A112.3.1 Performance Standard and Installation Procedures for Stainless Steel Drainage Systems for Sanitary, Storm and Chemical Applications Above and Below Ground
 5. AWWA C604 Installation of Steel Water Pipe 4 in and Larger
 6. AWWA M11 Steel Water Pipe: A Guide for Design and Installation
- C. Refer variances between above documents and Contract Documents to Owner's Representative.
- D. Install pipe to tolerances recommended by Manufacturer. Where no grade is shown, install pipe true and level using precision gauges and levels.
- E. Install pipe in neat and workmanlike manner, properly aligned and cut from measurements taken at site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary, all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- F. Firmly support and anchor all piping with fabricated or commercial hangers or supports in accordance with the Specifications. Where necessary to avoid stress on equipment or structural members, pipes shall be anchored or harnessed. Provide expansion joints and guides as needed to compensate for pipe expansion due to temperature differences.
- G. Valves and Unions: Unless otherwise indicated, all connections to fixtures, groups of fixtures, and equipment shall be provided with shutoff valve and union, unless valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.
- H. Threaded joints shall conform to ANSI/ASME B 1.20.1, and joints shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.
- I. Welded joints shall conform to specifications and recommendations of ANSI/ASME B 31.1 and AWS B2.1. Where conflicts occur between these documents, AWS B2.1 shall govern.
1. All welding shall be done by skilled and qualified welders.
 2. Minimize field welding using couplings and prefabrication of pipe systems at factory.
 3. Pipe butt welds may be performed at job site, providing butt welds are performed with an inert gas shielded process and other welding requirements are followed.
 4. Provide full penetration welds, free of cracks, overlaps and cold laps.

5. Electrodes for manual welding shall not be larger than 3/16 inch for shop-welding, nor larger than 5/32 inch for field welding.
 6. Depth of each pass shall not exceed 0.125 inch.
 7. Do not undercut more than 1/32 inch or 10% of base metal thickness, whichever is less.
 8. Remove all residue, oxide, and heat stain from any type of field weld and affected adjacent areas using stainless steel wire brushes, followed by cleaning with an agent such as Eutectic Company's "Euclean" or equal, followed by complete removal of agent.
 9. Sequence of welding and welding procedures shall in all cases be subject to approval by Owner's Representative.
- J. Welding shall be performed by SMAW process, using direct current and electrodes in accordance with AWS A5.4 and AWS A5.9
1. Use Class E316L electrodes for stainless to stainless welds.
 2. Use Class E309L or Class E312 electrodes for stainless steel to carbon steel welds.
 3. Use Class E308L electrodes for welding Type 304L to Type 304L
- K. Welding of Schedule 20S stainless shall be by GTAW process. Interpass temperature shall not exceed 350° F. Stress relieving shall be required, as directed by Owner's Representative.
- L. Postweld heat-treatment, if required by Owner's Representative, shall consist of heating material to temperature between 1900°F and 1950°F, and quenching it in water or cooling rapidly by other means. Where this is not possible, stress relieving shall be done at 750°F, maximum, for 4 hours plus additional 0.5 hour for each full inch of thickness over 0.5 inch.
- M. Thoroughly clean each layer of deposited weld metal with power-driven stainless steel wire brush prior to deposition of each additional layer of weld metal and also after final pass.
- N. Welds shall be deburred and ground smooth by using grinding wheels. Carborundum or other carbon-bearing wheels shall not be used on stainless steel surfaces.
- O. Stainless steel welds shall be pickled and passivated after fabrication in accordance with ASTM A380.
- P. Clean contaminated stainless steel surfaces in accordance with ASTM A380 and as approved by Owner's Representative.
- Q. Grooved Joints: Make grooves for grooved couplings and fittings with specially designed grooving tools to the Manufacturer's recommendations and conforming to ANSI/AWWA C606. All grooves shall be clean and sharp without flaws. Pipe ends shall be accurately cut at 90 degrees to the pipe axis.

3.3 FIELD QUALITY CONTROL

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Stainless Steel Pipe	Absence of sharp edges, weld spatters and burrs	Visual inspection by Owner's Representative	As directed	Owner	Owner
	Radiograph Inspection of Butt Welds	AWS D1.1	All butt welds in pipe 20 inches or larger	Contractor	Contractor
	Ultrasonic or Air Carbon Arc Gouging Inspection of Welds	AWS D1.1	All field welds not x-rayed	Contractor	Contractor
	Air Soap Test	See below	All slip-on flanges	Contractor	Contractor
	Liquid Penetrant Test	See below	As directed	Contractor	Contractor
	Inspection report	ASTM D100 Section 11.2	1 written inspection report	Contractor	Contractor
	CBC Chapter 17 Special Inspection	AWS CWI Special Inspector selected by Owner to inspect for compliance with AWS D1.1, D1.6 and standards listed in CBC Table 1704.3	Per CBC Table 1704.3	Owner	Owner
	Hydrostatic Test	Whitebook	All stainless steel pipe	Contractor	Contractor
	Anchorage and Support of Exposed Pipe	Visual inspection of finished installation. Support per UPC Table 3-1 and 3-2	1 inspection	Owner	Owner
	Installation & Leakage	Visual inspection of finished installation. No visible leaks.	1 inspection	Owner	Owner
11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor	

3.4 INSPECTION OF WELDING

A. Each weldment shall be examined and measured to ensure conformance to these specifications as follows:

1. Weld examination shall include shop fabrication and field welding.
2. Welds shall be visually inspected for deficiencies in materials and workmanship in accordance with these specifications. There shall be no

evidence of oxidation in the weld metal. Each weld shall produce complete fusion of joint, free of pinhole, crack, and slag-entrapment or –inclusion.

3. Nozzle and coupling welds shall be back-gouged to sound metal and examined by liquid-penetrant or magnetic-particle procedure prior to welding from opposite side.
4. Prior to weld-out, the root pass of socket-welded joints shall be liquid-penetrant examined.
5. Defective welds shall be chipped out and re-welded, and affected joints shall be re-checked by nondestructive testing for acceptance of repaired welds.
6. Welding that is unacceptable shall be subject to removal, re-welding, and 100 percent radiographic testing.

3.5 SOAP AND COMPRESSED AIR TESTING

- A. Slip on flanges and fittings and other joints susceptible to this test shall be tested by the soap and compressed air method.
- B. As soon as practicable after completion of welding of joints to be tested by soap and compressed air test, Contractor shall subject each joint to soap test by forcing compressed air, at approximately 15 psi, into each joint. While joint is under pressure, swab every portion of every welded seam forming a part of joint with heavy soap solution or approved, commercial, bubble-producing leak-test fluid and carefully examine for leakage. Contractor shall repair defects disclosed by test by chipping out and re-welding chipped section, after which same test shall be reapplied. Contractor shall provide apparatus and materials for making tests, shall drill and tap necessary holes, and shall plug-weld holes after testing.

3.6 LIQUID PENETRANT TESTING

- A. Liquid penetrant testing shall be in accordance with Manufacturer's written recommendations and witnessed by Owner's Representative. Liquid penetrant testing may be performed by non-ASNT certified personnel trained in the procedure.
- B. When joints are modified to provide tapered transition reinforcement at joint offsets, weld-metal buildup shall be examined over full surface of deposit by liquid-penetrant examination.
- C. Shop welds not tested by soap and compressed air test shall be tested by liquid-penetrant inspection method (on all root and final weld passes) as specified in ASME BPVC, Section VIII. Welds shall be evaluated based on visual inspection.
- D. Where temporary attachments have been made, base metal shall be tested by liquid-penetrant and shall be inspected for base metal tears.

3.7 CLEANING AND DISINFECTION

- A. Clean and disinfect pipe in accordance with the Specifications.

3.8 PROTECTION

- A. At all times when pipe laying is not in progress, open end of pipe shall be closed with tight-fitting cap or plug to prevent entrance of foreign matter into pipe. These

provisions shall apply during noon hour as well as overnight. In no event shall pipeline be used as drain for removing water which has infiltrated into trench. Contractor shall maintain inside of pipe free from foreign materials and in clean and sanitary condition until acceptance by Owner's Representative.

****END OF SECTION****

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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 OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.
- C. Single Manufacturer: Where two or more valves of the same type or size are required, the valves shall be furnished by the same manufacturer.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 01300 Contractor Submittals
 - 2. Section 01730 Operation and Maintenance Information
 - 3. Section 09800 Protective Coatings
 - 4. Section 11000 Equipment General Provisions
 - 5. Section 15000 Piping Components
 - 6. Section 15101 Valve and Gate Operators
 - 7. Section 15113 Air Release and Vacuum Valves
 - 8. Section 15116 Stainless Steel Valves 3-inches and Smaller
 - 9. Section 15117 Pump Control Valves and Pressure Relief Valves
 - 10. Section 15120 Altitude Valves
 - 11. Greenbook Section 212-5

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 City of San Diego Supplement Amendments (Whitebook).

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 Alloy 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 Gray 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 OWNER'S MANUAL

- A. The following shall be included in the OWNER'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 valve Section. In lieu of testing the valves at an independent testing laboratory, proof-of-design testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory representative. Proof-of-design testing shall have been performed on not less than three valves, with all three units demonstrating full compliance with the test standards. Failure to satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's 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.
- 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:** Protective coatings and linings for buried and exposed valves shall be in accordance with 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, 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 OWNER, 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 Metals.

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.

2.7 BRONZE BALL VALVES

- A. Use 2-piece standard port bronze ball valves with a blowout proof pressure retaining stem, Durafill® seats (1/4"-1/2" and 1-1/4" – 4") or Uniseal® seats (3/4" & 1"), reinforced PTFE stem packing seal and chrome plated brass ball. Valves with top loaded stems or valves without adjustable packing are not acceptable. Pressure rating no less than 150 psi on lines 2 inches (50.8 mm) and less. Must conform to MSS-SP-110 and be a Watts Series B6000 or equal. Use threaded NPT end connections.

2.8 BRONZE DOUBLE CHECK ASSEMBLY

- A. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single bronze or stainless steel access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks and a strainer. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assembly shall be a Watts Series 007 or equal. Pressure rating minimum 150 psi.

2.9 HOSE BIBB

- G. Use quarter turn hose bibbs suitable for temperatures to 180 degrees Fahrenheit. Ends shall be male x Hose or FIP x Hose. The body, adapter, stem and ball shall be brass with a nitrile O-ring, PTFE seat, zinc handle, aluminum I.D. tag and steel screw. Shall be key operated with removable handle. Minimum 150 psi pressure rating.

2.10 BRONZE CHECK VALVE

- A. All check valves 2" and smaller shall be horizontal swing, Y-pattern with a renewable seat and disc and suitable for potable water and mounted in either horizontal or vertical installation. The bonnet, body, disc hanger, disc holder, seat disc nut shall be bronze

conforming to ASTM B62. The seat disc shall be Buna-N rubber. Ends shall be threaded or solder. Minimum 150 psi pressure rating.

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****

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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 OWNER for compliance with the requirements of each valve and gate section. Unless otherwise indicated, the single manufacturer shall be the manufacturer of the valve or gate. Where two or more valve or gate operators of the same type or size are required, the operators shall all be produced by the same manufacturer.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 01300 Contractor Submittals
 - 2. Section 09800 Protective Coatings
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 15000 Piping Components

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 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 with Section 01300 - Submittals and 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 OWNER'S Personnel:** The authorized service representative shall also furnish the indicated services for instruction of the OWNER'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.
- 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, or equal. Covers of valve boxes shall be permanently labeled as requested by the OWNER or the CONSTRUCTION MANAGER. Wrench-nuts shall comply with AWWA C500, and a minimum of two operating keys, or one key per 10 valves, whichever is greater, shall be furnished. Painting of the exposed surface of valve well caps shall be in accordance with City of San Diego Standard Drawing SDW-107.
- C. **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.
- D. **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 H20 traffic rated.
- E. **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.
- F. **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: Field 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 15113

AIR RELEASE AND VACUUM VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide air release, air/vacuum, combination vacuum relief air inlet and air release valves 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 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 01300 - Submittals and 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 minimum 150 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 Buna-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.
- C. **Combination Vacuum Relief Air Inlet and Air Release Valve:** Combination Vacuum Relief Air Inlet and Relief Valves shall be installed at the two locations as shown on the plans. Each location shall include two - 2" valves, one as the main and one for redundancy. The valves shall be designed to allow large volume air entry through the large diameter air inlet orifice when a vacuum occurs in a system, then close air tight trapping the air as the system returns to positive pressure. While the large orifice is closed, the smaller size air release orifice remains open to slowly release trapped air in a controlled manner, to prevent water hammer and excess pressure surges.

The small orifice air release valve shall be 5/16" and operate with a compound lever mechanism of stainless steel, actuated by a stainless steel float.

The air inlet valve, internal plug and seat, shall be heavy cast bronze: the seat retained in the body by a heavy cover, have a (molded, not glued) resilient Buna-N seal for positive shut-off and plug center guided both ends to prevent jamming. The plug shall be normally closed by means of a stainless steel spring and shall open when a vacuum pressure differential exceeds 0.25 psi. The combination air inlet valve shall be rated 125lb Class minimum.

- D. **Air Release Valves:** These valves will have much smaller orifices than air/vacuum valves and the function is to release small pockets of air gathering at high points filled and under pressure. The body and cover shall be ductile iron with stainless steel float, needle, linkage and other internal parts. Air release valves shall have minimum pressure ratings of 150 psi with threaded inlets.

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.
- C. Combination Vacuum Relief Air Inlet and Air Release Valve: APCO Series 1500TC 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.
- D. Combination Vacuum Relief Air Inlet and Air Release Valve shall be installed where shown on the plans and in accordance with manufacturers recommendations.

****END OF SECTION****

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SECTION 15116

STAINLESS STEEL VALVES 3-INCHES AND SMALLER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of valves 3-inches and smaller on the customer side of meters and laterals including
 - 1. Drain, waste and vent systems.
 - 2. Air piping.
 - 3. Process piping.
- B. Utility work on Utility side of meters and laterals is typically covered by other sections which reflect the particular standards for the Servicing Utility.

1.2 RELATED WORK

- A. Section 01300: Contractor Submittals
- B. Section 15065: Stainless Steel Pipe
- C. Section 15116: Bronze Valves 3-inches and Smaller
- D. Section 15175: Hydropneumatic Surge Control System

1.3 SYSTEM DESCRIPTION

- A. Furnish and install complete operating valves as shown including appurtenant structural, mechanical and/or electrical mountings, connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 QUALITY ASSURANCE

- A. National Sanitation Foundation marking shall appear on all potable water valves.
- B. National Sanitation Foundation Marking is not required for piping in nonpotable water drainage service.
- C. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Butterfly Valve	Seat Bond	ASTM D429 Method B withstand 75 lb pull	1 each valve	Contractor	Contractor
	Proof of Design	ASTM C504	Cycle testing per C504	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Leakage Test	AWWA C504 and ASTM D1599	1 each valve	Contractor	Contractor
	Hydrostatic Test	AWWA C504	1 each valve	Contractor	Contractor
Powered Actuators	Proof of Design	See Section 13422	1 test on one actuator	Contractor	Contractor
	Performance	See Section 13422	1 test on each actuator	Contractor	Contractor

1.5 REFERENCES

- A. ASME/ANSI A112.4.14 Manually Operated Quarter-Turn Shutoff Valves for Use in Plumbing Systems Valves
- B. ASME/ANSI A112.14.1 Backwater Valves
- C. ASME/ANSI B1.20.1 NPT National Pipe Thread Taper
- D. ANSI/ASME B2.4
- E. ANSI/ASME B16.3 Malleable Iron Threaded Fittings, Class 150 and 300
- F. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- G. ASME/ANSI B16.33 Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psi (Sizes NPS 1/2 –NPS24)
- H. ASME/ANSI B16.34 Valves – Flanged, Threaded and Welding End
- I. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
- J. California Plumbing Code
- K. NEMA/ANSI 250 Enclosures for Electrical Equipment
- L. NFPA 70 National Electric Code
- M. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 SUBMITTALS

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for each type of valve per shop drawing requirements.	
Catalog Data	Required for each type of valve per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance Instruction requirements.	

SUBMITTAL	DESCRIPTION	
Certificate of Compliance	Submit certified report of testing of factory-applied linings	
Warranty	Furnish one-year warranty from date of final acceptance for plumbing fixtures.	

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of plumbing, fixtures, and appurtenant equipment shall be strictly followed.

1.8 UNIT PRICES

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers for stainless steel valves include the following:

ITEM	MANUFACTURER	MANUFACTURE R LOCATION
Stainless Steel Backpressure (Anti-siphon) Valves	Griffco Valve Inc G Series	Amherst, NY
	Accepted equal	
Stainless Steel Ball Valves 3-inches and smaller	Apollo Valve Div Conbraco Industries 76 Series	Matthews, NC
	Sharpe	Chicago, IL
	Accepted equal	
Stainless Steel Check Valves 3-inches and smaller	Apollo Valve Div Conbraco Industries 62 Series	Matthews, NC
	Accepted equal	
Stainless Steel Swing Check Valves 3-inches and smaller Class 200	Stockham Valves & Fittings Fig 20SS	Birmingham, AL
	Accepted equal	
Stainless Steel Direct-Acting Pressure Reducing or Pressure Regulating Valves ¼" through 2"	Apollo Valve Div Conbraco Industries 36 Series	Matthews, NC
	Cla-Val Model CRA and 990	Newport Beach, CA
	Accepted equal	
Stainless Steel Direct-Acting Pressure Relief Valves ¼" through 2"	Cla-Val Model CRL and 55F	Newport Beach, CA
	Griffco Valve Inc G Series	Amherst, NY
	Accepted equal	
Stainless Steel 2-Way Solenoid Valves Class 150 or 200	ASCO Red Hat (8210 Series)	Alpharetta GA
	Accepted equal	
Stainless Steel 3-Way Solenoid Valves Class 150	ASCO Red Hat (8300 Series)	Alpharetta GA
	Accepted equal	

2.2 MATERIALS

- A. Valve materials shall be chemically compatible with chemicals and solutions handled. If any portion of a specified valve is not chemically compatible with chemicals or solutions handled, substitute an appropriate valve during submittals, stating reason for exception.
- B. Valves shall have name of Manufacturer and size of valve cast or molded onto valve body or bonnet or shown on permanently attached plate.
- C. Stainless steel backwater valves shall comply with ASME/ANSI A112.14.1 and shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Stainless Steel	SAE Type 316

- D. Stainless steel ball valves shall comply with ASME/ANSI A112.4.14 and shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Valve Body and Disc	Stainless Steel	SAE Type 316
O-Rings and Seals	EPDM	
Trim	Stainless steel	SAE Type 316

- E. Stainless steel check valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Valve Body and Disc or Poppet	Stainless Steel	SAE Type 316
O-Rings and seals	EPDM	
Trim	Stainless steel	SAE Type 316

- F. Diaphragm valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Valve Body and Cover	Stainless Steel	SAE Type 316
Diaphragm	EPDM	
Trim	Stainless steel	SAE Type 316

- G. Stainless steel solenoid shutoff valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Valve Body and Poppet	Stainless Steel	SAE Type 316
Bellows Protecting Poppet Stem	PTFE (Teflon)	Corrosion-resistant to prevent contact with chemical solution
Upper End Bellows Seal	EPDM	
Trim	Stainless Steel	SAE Type 316

- H. Stainless steel solenoid pressure relief valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Valve Body and Poppet	Stainless Steel	SAE Type 316

ITEM	MATERIAL	SPECIFICATION
Bellows Protecting Poppet Stem	PTFE (Teflon)	Corrosion-resistant to prevent contact with chemical solution
Upper End Bellows Seal	EPDM	
Trim	Stainless Steel	SAE Type 316

I. Water hammer arrestors shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Valve body	Stainless Steel	PD1 WH-201 approved

J. The following product design criteria, options and accessories are required on stainless steel valves:

ITEM	DESCRIPTION	
Stainless Steel Ball Valves 2-inches and smaller	Actuator	Quarter-turn handle operator
	Stem	Nonblowout
	Function	Shutoff
	Fluid Conveyed	Air and potable water
	Flow Pattern	2-way
	Style (Multiport Valves)	Horizontal
	Position Indicator	Required
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150F)
Ends	Female threaded ASME/ANSI B1.20.1	
Stainless Steel Check Valves 3-inches and smaller	Pattern	Wye
	Disc	Swing Type
	Function	Backflow prevention
	Fluid Conveyed	Air and potable water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150F)
	Ends	Female threaded ASME/ANSI B1.20.1
Stainless Steel Pressure Reducing Valves (Regulators)	Function	Automatic, direct pressure actuated Capacity labeled and ASME certified.
	Standard	ASSE 1003
	Fluid Conveyed	Potable water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150F)
	Ends	Female threaded ASME/ANSI B1.20.1
Stainless Steel Pressure Relief Valves	Automatic, direct pressure actuated Capacity labeled and ASME certified.	
	Fluid Conveyed	Potable Water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150F)
	Ends	Female threaded ASME/ANSI B1.20.1
Stainless Steel Solenoid Valves	Actuator	Per surge tank manufacturer recommendation
	Function	On hydropneumatic system
	Fluid Conveyed	Air
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150F)
	Ends	Female threaded ASME/ANSI B1.20.1

ITEM	DESCRIPTION	
	Electrical Requirements	See below
	Duty	Continuous duty

K. The following product design criteria, options and accessories are required for valves:

ITEM	DESCRIPTION	
Solenoid Shutoff Valve	Valve shall have a fail-dry chamber and a secondary diaphragm such that if seal fails, chemical solution can be contained in valve and valve can continue operation Equip valve with contactor indicator that lights when valve is energized	

L. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION	
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant
	Submergence Rating	72-hour 20-feet of head per IP68
Power Supply	Solenoid	120VAC – 1 phase – 60Hz

PART 3 - EXECUTION

3.1 PREPARATION

- A. Make field measurements needed to install valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Remove scale and dirt on inside and outside of valves before assembly.

3.2 INSTALLATION

- A. Furnish and install valves at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing, and mechanical code requirements
- C. Refer variances between the above documents and Contract Documents to Owner's Representative.
- D. Use valve hangers and supports as detailed on the drawings, as specified, and as required by applicable plumbing codes.
- E. Obtain and review dimensioned shop drawings from valve suppliers before roughing in for any equipment.

- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Install vacuum breakers to entirely eliminate any danger of siphoning waste materials into the water supply system.
- H. Painting and Coating shall comply with Division 9.

3.3 Field Quality Control

- A. Use adequate numbers of skilled plumbers trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods needed for proper performance of Work of this section.
- B. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
All Stainless Steel Valves	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See sections of Contract Documents covering pressure tests	1 test	Contractor	Contractor
	Actuator	Operate valve through 10 full cycles of opening and closing. Valve shall operate from full open to full close without sticking, or binding and without required operating torque exceeding 150 ft-lbs at any point	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance of fixtures and equipment to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance of all work to Contract Documents and Manufacturer's printed literature	1 inspection	Owner	Contractor

****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 extent required for proper performance of the WORK.

Section 01660 Facility Startup and Operator Training

Section 02666 Water Pipeline Testing and Disinfection

Section 09800 Protective Coating.

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 City of San Diego Supplement Amendments.

B. Except as otherwise indicated, the current editions of the following standards apply to the Work for this Section

- | | | |
|----|-------------|---|
| 1. | ASTM A216 | Standard Specification for Steel castings, Carbon, Suitable for Fusion Welding for High Temperature Service |
| 2. | ASTM A536 | Standard Specification for Ductile Iron Castings |
| 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 and Section 01300.

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 Owner'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-BT (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

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.

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.

The stem shall be fully guided through its complete stroke by a removable bearing in the valve cover and an integral bearing in the valve seat. The stem shall have machined flats on its shoulder or other means to facilitate disassembly. All pump control/pressure relief valves shall come equipped with a specially designed stem with angled rifling, or other design, that channels deposits away and minimizes the risk of scale buildup or other mineral deposits from seizing the valve.

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.

The Contractor shall require the valve manufacturer to warrant the valve to be free of defects in material and workmanship for a period of one year from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. The valve manufacturer shall be able to supply a complete line of equipment from 1-1/4" through 16" sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation analysis which shows flow rate, differential pressure, percentage of valve opening, Cv, system velocity, and the incidence of cavitation damage.

2.3 MATERIALS OF CONSTRUCTION--DIAPHRAGM-ACTUATED VALVES

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
Pilotry (Valves, strainers, flow controls, other appurtenances)	Bronze body, ASTM B 62 and B61
Pilotry (Tubing)	Type 316 stainless steel
Stem sleeves	Type 303 stainless steel or Xylan impregnated
Elastomers	Buna-N
Cover screws, caps, and nuts and bolts	Type 316 stainless steel

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. Class 150 Pressure-Relief Valves:

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. Class 150 Pump Control Valves:

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.

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.

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.

An emergency closing feature shall be provided to close the valve at a controlled rate in the event of motor power loss.

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.

Flanges shall be Class 150, ASME B16.42. Valve shall be globe pattern.

2.7 BOLTS AND NUTS FOR FLANGED VALVES

Bolts and nuts for flanged valves shall be as specified for the piping to which the valves are connected.

Provide washers for each nut. Washers shall be of the same material as the nuts.

2.8 GASKETS FOR FLANGES

Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2.9 SPARE PARTS

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.

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

Ship and deliver valves in accordance with AWWA C530, Section 6 and as follows.

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.

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.

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.

Protect the valve and pilot system from weather and the accumulation of dirt, rocks, and debris. Also, see the manufacturer's specific storage instructions.

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.

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 and line interiors of valves with fusion bonded epoxy per Section 09800.
- B. 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	6-inch diameter
Maximum flow (gpm)	1,600
Minimum flow (gpm)	500
Maximum upstream pressure (psi)	115
Minimum upstream pressure (psi)	85
Maximum downstream pressure (psi)	60
Minimum downstream pressure (psi)	10
Pressure-relief setting (psi)	125

- B. Pump Control Valve service conditions shall be as shown below.

Pump Control Valve	6-inch diameter	10-inch diameter
Maximum flow (gpm)	600	1,000
Minimum flow (gpm)	30	175
Maximum upstream pressure (psi)	115	115
Minimum upstream pressure (psi)	10	10
Maximum downstream pressure (psi)	115	115
Minimum downstream pressure (psi)	85	85

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, reseal 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. See Section 02666 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 15118
EXPANSION JOINTS

PART 1 - GENERAL

1.1 Work Included

- A. This section includes materials, testing, and installation of expansion joints.

1.2 Related Work

- A. Section 01330: Contractor Submittals
- B. Section 01730: Operator and Maintenance Information
- C. Section 09800: Protective Coating
- D. Section 09867: Polyethylene Sheet or Tube Encasement

1.3 System Description

- A. Furnish and install complete operating expansion joint system including appurtenant structural, and mechanical mountings thrust restraints or connections and coatings required for compliance with Manufacturer's installation requirements, and compliance with AWWA and other applicable standards.
- B. Double-ball expansion joints shall be capable of accommodating minimum design displacements for piping attachments to tanks and mechanical equipment shown in ASCE 7 Table 15.7-1, when unrestrained.
- C. Unless otherwise shown in the Special Provisions, expansion joints shall be force-balanced, self-restraining type. The expansion joint must not impart a thrust force on the piping system while under internal pressure. If expansion joints are not force-balanced, Contractor shall make provisions for restraining joints from damaging adjacent tanks and piping during testing.

1.10 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fusion-Bonded Epoxy Linings	Holidays and Lining Thickness	See Section 09800	1 each item	Contractor	Contractor

1.11 References

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- B. ASME/ANSI B16.21 Non Metallic Gaskets for Pipe Flanges
- C. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- D. ASTM A193 Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
- E. ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
- F. ASTM A536 Ductile Iron Castings
- G. ASTM A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- H. AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems
- I. AWWA C115/ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- J. AWWA C153 Ductile Iron Compact Fittings for Water Service
- K. AWWA C221 Fabricated Steel Mechanical Slip-Type Expansion Joints
- L. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- M. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.12 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation instruction requirements.	
Warranty	Furnish three-year warranty from date of final acceptance	

1.13 Delivery, Storage and Handling

- A. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of expansion joints shall be strictly followed.

1.14 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.3 Acceptable Manufacturers

A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Bolt Coating on Buried Bolts	3M Company (EC 244)	St. Paul, MN
	Carboline Bitumastic No. 50	St Louis, MO
Bolt Coating on Buried Bolts	Tnemec Co. (46-465 H.B. Tnemecol)	Kansas City, MO
	Accepted equal	
Expansion Joints – Double Ball Type Force Balanced	EBAA Iron (Forced Balanced Flex-Tend)	Eastland, TX
	Accepted equal	
Polyethylene Encasement for Buried Ductile Iron Expansion Joints	Christy's "AWWA Polywrap"	Anaheim, CA
	Northtown Company	Huntington Beach, CA
	Trumbull Industries, Inc.	Youngstown, OH
	Accepted equal	

2.4 Materials

A. Products shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Flanges	Cast Iron or Ductile Iron	Raised or plain faced
	Pressures 0-250 psi	ASME/ANSI B16.1 Class 125 Cast Iron or ASME/ANSI B16.42 Class 150 Ductile Iron
Flange Bolts, Nuts, Washers and Gaskets	Various steels	See Section 15000
Expansion Joints – Double Ball Type	Ductile Iron	Conform to material properties of AWWA C153
Lining (Expansion joints 3-inches and larger)	Fusion Bonded Epoxy	AWWA C213 15 mil minimum DFT Meet NSF 61 for potable water applications
Exterior Finish Coat	Fusion Bonded Epoxy	AWWA C116, 6 mil minimum DFT
Polyethylene Encasement on Buried Joints and Appurtenances	Polyethylene Sheet	AWWA C105 2 layers, 8 mils each

B. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Coating on Buried Bolts, Nuts and Tie-rods	Epoxy	2 coats minimum 10-12 mils MDFT per coat Stainless steel hardware is a suitable alternative
Expansion Joints – Double Ball Type	Ends	Flanged
	Minimum Expansion	8 inches
	Expansion/Contraction Pre-setting	50% expansion-50% contraction on horizontal installations

ITEM	DESCRIPTION	
		75% expansion-25% contraction on vertical installations
	Minimum Deflection	15 degrees per ball
	Self-Contained Restraint	larger of 250 psi or rating of mating flanges

- C. Flanges shall conform to AWWA C115/ANSI A21.15 and shall mate with adjacent valves or fittings.
- D. Internal bore of couplings and joints shall be as close to that of pipe system as is commercially available.

PART 3 - EXECUTION

3.5 Preparation

- A. Make field measurements needed to install products before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. On buried couplings and assemblies, lubricate all threaded parts including bolts and compression collars before assembling couplings and joints.

3.6 Installation

- A. Furnish and install expansion joints at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing and mechanical code requirements
- C. Refer variances between the above documents and Contract Documents to Owner's Representative.
- D. Expansion joints shall be furnished and installed by Contractor at location shown on Plans and Submittals.
- E. Refer variances between Manufacturer's installation instructions and Contract Documents to Owner's Representative.
- F. Bolting shall be completed as follows:
 - 1. Wire brush and clean flange before joining flange.
 - 2. Lubricate bolt threads with graphite and oil.
 - 3. Boltheads and nuts shall rest squarely against the metal. Draw boltheads and nuts tight against the work using a suitable wrench not less than 15 inches long or a

torque wrench set to provide a similar torque. Tap boltheads with a hammer while nut is being tightened. After being tightened, nuts shall be locked.

4. Bolts shall extend entirely through the nut projecting at least ¼ inch but not more than 3/8 inch beyond outside face of nut.

G. Encase all buried couplings and appurtenances with two layers of polyethylene wrap.

3.7 Field Quality Control

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Expansion Joints –	Restraint	Test joint against its own restraint at specified test pressure in presence and under direction of factory authorized Manufacturer's representative. Install at least 4 tie rods between expansion joint flanges during test	1 each joint	Contractor	Contractor
	Laying Length	Compare to laying length shown on submittal to verify factory presetting for expansion/contraction is provided.	1 each joint	Owner	Owner
	Flexibility	Field demonstrate joint can move through full range of motion and offset described in Manufacturer's submittal literature by bolting one end of unit to flange and moving free end with backhoe or forklift.	1 inspection	Contractor	Contractor
	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

****END OF SECTION****

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SECTION 15120

ALTITUDE VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Materials, testing, and installation of pilot-operated altitude valves.

1.2 RELATED WORK

- A. Section 15100 Valves, General
- B. Section 09800 Protective Coating

1.3 SYSTEM DESCRIPTION

- A. Furnish and install complete operating pilot-operated control valves including appurtenant structural, mechanical and/or electrical mountings or connections and pilots required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Valves shall be diaphragm-actuated. Do not use piston-actuated valves.
- C. Unless otherwise shown, valve bodies shall be full-cross-section globe pattern valve similar to ClaVal Model 100-01 Hytrol or 100-02 Powertrol as applicable. Do not use reduced section.
- D. Altitude valve for two-way flow (ClaVal Series 210-16 / Singer Series 106 A-Type 1) shall control high water level in tank without need for floats or other devices. Valve shall not throttle. Valve shall remain fully open until shut-off point is reached. Valve shall close at high water level and open for return flow when pressure at valve inlet falls below reservoir pressure.
- E. Valves shall be hydraulically actuated diaphragm type. Body shall contain removable seat insert, Resilient disc shall form drip-tight seal with valve seat when pressure is applied above diaphragm. Diaphragm assembly shall form sealed chamber in upper portion of valve, separating operating pressure from line pressure. Diaphragm shall not be used as sealing surface. Guides shall be provided at both ends of stem. Provide bearing in valve cover and integral bearing in valve seat.
- F. Pilot control system shall include fixed orifice, and shall be manufactured by same company manufacturing main valve.
- G. If valve fails, valve shall automatically close or remain in closed position.
- H. Repairs and modification other than replacement of main valve body shall be possible without removing main valve from service.
- I. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pilot-Operated Control Valves	Hydrostatic Seat Leakage Test	AWWA C530 Section 5.2.3	1 each valve	Contractor	Contractor
	Hydrostatic Test	AWWA C530 Section 5.2.4	1 each valve	Contractor	Contractor
	Proof of Design Test	AWWA C530 Section 5.2.5	1 each prototype	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09800	1 each valve	Contractor	Contractor

1.5 REFERENCES

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- B. ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings
- C. ASME/ANSI B16.15 Cast Bronze Threaded Fittings
- D. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- E. ASTM B75 Seamless Copper Tube
- F. ASTM B88 Seamless Copper Water Tube
- G. AWWA C213 Fusion-Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
- H. AWWA C530 Pilot-Operated Control Valves
- I. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

1.6 SUBMITTALS

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for valves per valve and equipment shop drawing requirements.	.
	Required for solenoid operated valves under electrically controlled equipment shop drawing requirements.	
Catalog Data	Required per catalog data requirements.	
	Include Manufacturer's maximum recommended flow and maximum operating pressure.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements.	
Certificates of Compliance	Submit certified report of testing of factory-applied linings	
Engineering Calculations	Required for cavitation per engineering calculations requirements.	

SUBMITTAL	DESCRIPTION	
	If calculations show valves shown in Contract Documents to be improperly sized or specified, submit letter to Owner's Representative requesting appropriate variance.	
Warranty	Furnish one-year warranty from date of final acceptance	

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of pilot-operated control valves shall be strictly followed.

1.8 UNIT PRICES

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pilot-operated control valves shall conform to AWWA C530 and NSF/ANSI 61
- B. The stem shall be fully guided through its complete stroke by a removable bearing in the valve cover and an integral bearing in the valve seat. The stem shall have machined flats on its shoulder or other means to facilitate disassembly. All pump control/pressure relief valves shall come equipped with a specially designed stem with angled rifling, or other design, that channels deposits away and minimizes the risk of scale buildup or other mineral deposits from seizing the valve.
- C. Unless otherwise stated, pilot-operated control valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Main Valve Body and Cover, Disc Retainer and Diaphragm Washer	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12 / ASTM A395
Main Valve Trim, Disc Guide, Seat and Cover Bearing	Stainless Steel	ASTM A276 or A351 SAE Type 316
Stem, Nut and Spring	Stainless Steel	Type 316 Provide Durakleen stem on Cla-Valve products carrying potable water. Provide oxy-nitrite treated stem for products other than Cla-Valve carrying potable water.
Disc	NBR Synthetic Rubber (Nitrile Butadiene Rubber) (Buna N)	ASTM D1418 Temperature Standard Class II to 230°F Meet NSF 61 for potable water applications Do not expose to acetone, esters, ketones, chlorinated hydrocarbons, nitro hydrocarbons, ozone or direct sunlight
Diaphragm	NBR Synthetic Rubber (Nitrile Butadiene Rubber) (Buna N)	ASTM D1418 nylon-reinforced Vulcanize at stem hole to prevent product wicking into diaphragm. Temperature Standard Class II to 230°F

ITEM	MATERIAL	SPECIFICATION
		Meet NSF 61 for potable water applications Do not expose to acetone, esters, ketones, chlorinated hydrocarbons, nitro hydrocarbons, ozone or direct sunlight
Bonnet Bolts, Nuts and Washers	Stainless Steel	ASTM A276 or A351 SAE Type 316 with anti-seize lubricant
Pilotry (Valves, strainers, flow controls and other appurtenances)	Cast Bronze with Stainless Steel Trim	Comply with NSF/ANSI 61 and NSF/ANSI 372 lead threshold for potable water applications ASTM B62 bronze may be used for recycled water applications
Pilotry (Tubing)	Stainless Steel	Type 316
Flanges Sizes 3"-48" Working Pressures 0-150 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle North-South and East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Stainless stell	Type 316
Flange Gaskets		See Section 15000
Epoxy Lining	Fusion-Bonded Epoxy (Cla-Valve KC suffix)	See Section 09800 AWWA C213 and AWWA C550 10 / 12 / 16-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas or bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09800

- D. The following product design criteria, options and accessories are required for pilot-operated control valves:

ITEM	DESCRIPTION			
	Valve Size	Flow Rate	C _v (Globe Valve)	C _v (Angle Valve)
Flow Rate and C _v	10"	300-4900 gpm	1245 gpm	1575 gpm
	12"	400-7000 gpm	1725 gpm	2500 gpm
	14"	500-8400 gpm	2300 gpm	3060 gpm
	16"	650-11000 gpm	2940 gpm	4200 gpm
Adjustment Range	Upstream pilot	20-200 psi		
	Downstream pilot	0-75 psi		
Maximum Chlorine Concentration	2 ppm			
Maximum Non-Shock Inlet Pressure	150 psi			
Maximum Transient Pressure	250 psi			

ITEM	DESCRIPTION
Minimum Expected Pressure Drop across Seat	5 psi
Maximum Expected Pressure Drop across Seat	40 psi
Maximum Open-Valve Head Loss at Maximum Continuous Flow	10 psi
Anti-Cavitation Trim	Manufacturer to perform cavitation calcs and install trim if necessary
Isolation Valves on Pilot Lines	Required on both sides of pilot
Check Valves with Cock on Pilot Lines	Required
Opening Speed Control	Not Required
Closing Speed Control	Required
In Line Strainer on Pilot Line Inlet Port	Not Required
In Line Y-Strainer on Pilot Line	Required
Position Indicator	Required
Position Transmitter	Required (Cla Valve E suffix) Transmitter (Discrete Open/Shut Signal) Required
Limit Switch on Valve Stem	Not Required
Independent Operating Pressure	Not required – Use upstream valve inlet pressure
Atmospheric Drain	Not Required
Electronic Controller	Not Required
Single-Tapped Bonnet	Required with ball valve fitted for quick exercising
Self-Cleaning Stem	Required Cla-Valve KD suffix
Delrin® Sleeved Stem	Not Required
Water Treatment Clearance	Not Required
Heavy Spring	Not Required
Pressure Gauges	Required (Cla Valve P suffix) on upstream and downstream chambers of valves per

PART 3 - EXECUTION

3.1 PREPARATION

- A. Make field measurements needed to install pilot-operated control valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 INSTALLATION

- A. Furnish and install pilot-operated control valves at locations shown on Plans and Submittals.
- B. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing, mechanical and electrical code requirements
- C. Refer variances between above documents and Contract Documents to Owner's Representative.
- D. Install pilot-operated control valves to tolerances recommended by Manufacturer. Unless otherwise shown, install valves true, plumb, and level using precision gauges and levels.

3.3 FIELD QUALITY CONTROL

- A. Valves shall be tested at same time connecting pipelines are pressure tested and in accordance with Contract Document sections covering testing. During pressure testing, protect or isolate valves, operators, or control and instrumentation elements whose pressure rating is less than test pressure.

- B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pilot-Operated Control Valves	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See sections of Contract Documents covering pressure tests	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

- C. Provide services of factory-authorized representative on-site for at least 2 man-days (travel time excluded) to provide:
 - 1. Installation assistance, inspection and startup of complete pilot-operated control valve system.
 - 2. Field testing and adjustment.
 - 3. Instruction of Owner's personnel in operation and maintenance.

3.8 SPARE PARTS

- A. Furnish the following spare parts:

QUANTITY	PART
1	Diaphragm and rubber kit

****END OF SECTION****

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SECTION 15156

MAGNETIC FLOW METERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes the purchase, materials, installation and testing of meter assemblies.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).

Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1. Section 09800: Protective Coating
2. Section 15065: Stainless Steel Pipe
3. Section 15100: Valves, General

1.03 APPROVED MANUFACTURERS

- A. Toshiba Flow Meter or equal

PART 2 - MATERIALS

2.01 GENERAL

- A. All meters shall be new and of current manufacture design.
- B. All parts of the meters of the same size and model shall be interchangeable.
- C. Parts: Detector, Converter, interconnection cables
- D. Manufacturer shall be ISO9000 and ISO14001 certified. As well as providing a written warranty by the manufacturer from defective materials or workmanship for a period of at least 10 years.
- E. Every unit regardless of size must be flow tested in a recognized flow testing facility that is traceable to the National Institute of Standards Technology (NIST) or other recognized standards authority. Flow coefficient referencing for larger sizes is unacceptable.

2.02 ELECTROMAGNETIC FLOW METER

- A. The meter type shall be an Electromagnetic flow meter, operating on Faraday's Law, using a pulsed DC type coil excitation with high impedance electrodes.
- B. Meter must be a full-bore meter with the magnetic field traversing to entire cross-section of the flow tube.
- C. The coil arrangement will be glass wrapped and secured to the inner liner with 304 SS brackets. The electrode wires shall be mounted in a live loaded sealing mounting arrangement. The electrode wires shall be placed within stainless steel conduits.
- D. Meter housing must be IP67 and NEMA 4X watertight.
- E. Each flowmeter shall be flow lab calibrated in the manufacturer's lab. The manufacturer will flow lab calibrate all meters twice at 0%, 50% and 100% of flow for a total of 6 flow point calibrations.
- F. Manufacturer must guarantee accuracies of +/-0.2% of rate or better with upstream lay length requirements before any obstructions is one pipe diameter. Vendor will also provide a written guarantee on upstream and downstream installation accuracy performance, also referred to as "install accuracy", per meter application.

The anticipated flow range for this project is between 30 gpm and 2,500 gpm. The manufacturer must provide a letter certifying flow accuracies within +/- 3.5% for flows between 30 gpm and 150 gpm and +/- 0.2% for flows between 151 gpm and 2,500 gpm.

- G. All flow meters must have 40 years or higher MTBF rated detector as printed in the vendor's specifications.
- H. The electromagnetic flow meter shall be a Toshiba Series LF or approved equal, 150# ANSI flanged, electrodes: 316L SST and anti-fouling, NSF Approved on NSF/ANSI Standard 61 Drinking Water System Components-Health Effects polyurethane rubber lining, 316 SST grounding rings.

2.03 TOTALIZER - TRANSMITTER

- A. The totalizer – transmitter shall be furnished with all necessary mounting hardware for operation from the meter.
- B. The transmitter shall have integrally mounted electronic circuitry to convert to both a true 2-wire 4-20 mA DC output linear to flow rate and a true 2-wire scaled pulse. The 4-20 mA DC output shall operate from an external regulated 18-30 VDC power supply with load capacity of 575 ohms at 28 VDC. The accuracy of the 4-20 mA output shall be better than +/- 0.5% of scale.
- C. The pulse output shall operate from an external regulated 10-30 VDC power supply which can be either the 4-20 mA DC power supply or a separate power supply. The pulse circuit voltage drop across the transmitter shall be 3 VDC or less. Each pulse shall represent the volume of the least significant totalizer digit.

- D. The electronic circuit board will be conformal coated for protection from moisture.
- E. The converter shall be Toshiba Series LF622FAC211E, full function dot-matrix 128x128 analog/digital LCD display backlit and rotatable, noninvasive 3-button infrared display, 100 VAC to 240 VAC power with capability of normal operation during abnormal voltage conditions from a minimum of 80 volts during low voltage conditions or a maximum of 264 volts during over voltage condition, with a 4-20 mA and pulse output. Converter housing must be NEMA 4X fireproof and made of corrosion resistance anodized aluminum with Acrylic resin coating.
- F. Provide adequate cable length between the converter and the detector.
- G. In-situ Calibration Verification/Self diagnostics: This built-in system shall be able to re-verify the meters current conditions vs. the meters condition when originally manufactured. Verification to be performed without need for physical access to the detector or need of other devices.

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****

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SECTION 15175

HYDROPNEUMATIC SURGE CONTROL SYSTEM

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. This specification describes the requirements for a Hydropneumatic Surge Control System. The purpose of the system is to minimize transient pressures from shock waves due to pump shutdown and startup, in addition to serving as a “day-tank” to alleviate the Soledad Booster Pumps during low-flow conditions. The System shall be designed for potable water service.
- B. Surge Tank shall be non-bladder type and shall be as shown on the Plans and specified herein.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300: Contractor Submittals
 - 2. Section 05500 Miscellaneous Metalwork
 - 3. Section 09800 Protective Coating
 - 4. Section 11000 Equipment General Provisions
 - 5. Section 15116 Stainless Steel Pipe
 - 6. Section 15020 Pipe Supports
 - 7. Section 15100 Valves, General

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS.

- A. Pressure vessels shall be in accordance with the latest revision of the American Society of Mechanical Engineers (ASME) Code for Unfired Pressure Vessels, Section VIII, Division 1.
- B. All local Plumbing Codes shall be met.
- C. The system and anchorage of the surge tank shall conform to the International Building Code (IBC).
- D. The National Electric Code (NEC) shall be used for all wiring.
- E. ASME/ANSI B1.20.1 NPT National Pipe Thread Taper
- F. ASME/ANSI B16.3 Malleable Iron Threaded Fittings, Class 150 and 300
- G. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)

- H. ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications
 - I. ASTM A105 Forgings, Carbon Steel for Piping Components
 - J. ASTM B61 Steam or Valve Bronze Castings
 - K. ASTM B62 Composition Bronze or Ounce Metal Castings
 - L. AWS/ANSI D1.1 Structural Welding Code – Steel
 - M. AWS/ANSI D1.3 Structural Welding Code - Sheet Steel
 - N. AWWA M11 Steel Pipe
 - O. California Building Code (CBC)
- 1.4 SUBMITTALS.
- A. Submittals shall be submitted in accordance with project specifications.
 - B. For review and approval.
 - 1. Drawings: Detailed surge tank fabrication drawings, system assembly and installation drawings. Show equipment weights and anchor bolt designs. Show weight of pressure vessel, both empty and filled with water.
 - 2. Product Data: Specifications for system components, accessories and protective coatings with installation instructions.
 - 3. Electrical: Complete electrical diagrams with power requirements. 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.
 - 4. 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.
 - 5. Welder Qualification Certificate
 - C. Included in Operation and Maintenance Manual.
 - 1. Instructions on installation, operation and maintenance of supplied components.
 - 2. Copy of ASME Pressure Vessel Code Form U-1A.
- 1.5 WARRANTY
- A. The supplied components shall carry a warranty of one year from initial operation or eighteen months from delivery whichever comes first.
- 1.6 SURGE ANALYSIS

- A. The manufacturer shall review and comply with the Surge Analysis Report developed by Flow Science. Manufacturer shall communicate any concerns or inconsistencies with Surge Analysis Report with the Resident Engineer.
- B. The pressure transients in the pipeline following pump shutdown/startup from design operating conditions must not cause cavitation or water column separation at any point in the pipeline and must not exceed the pressure rating of the piping at any point in the pipeline.
- C. The surge analysis must show pipeline profile, initial flow rate, initial and maximum expanded air volume and envelope of maximum and minimum line pressure throughout the pipeline. In addition, a predicted pressure-time history at the pump station and at other critical points in the pipeline will also be required.
- D. The surge tank must be designed to match the dynamics of the pumping station.
- E. There shall be no less than ten percent reserve water in the surge tank at the maximum outflow conditions (water seal volume).
- F. Results of the surge analysis shall clearly indicate that the design and size of the Surge Tank provided will adequately protect the system from excessive pressure surges, and shall show the Hydropneumatic Surge Control System will meet the Performance Guarantees in Section 3.2 of this Specification.

1.7 DESIGN AND PERFORMANCE REQUIREMENTS

- A. System Supplier to develop recommended set points in agreement with the Surge Analysis Report.
- B. System shall be tailored to the following conditions.

Service:	Outdoors environmental temperature range of 35°F to 105°F
Elevation:	725 feet above mean sea level
Tank volume:	4,500 gallons
Normal volume of air in tank:	50% tank size (2,250 gallons)
Max volume of air in tank at max pressure (113 psi)	75% tank size (3,375 gallons)
Tank Operating Pressure Range:	50 – 200 psig
Design pressure:	300 psig
Tank Test Pressure	1.3 x design pressure
Pressure rating of flanged outlets:	Class 150 per ASME B16.5 or Class E per AWWA C207
Tank inlet/outlet pipe size:	8-inch
Liquid level sight gauge pressure rating:	300 psi (water service)
Safety relief valve pressure rating:	300 psi WOG
Solenoid valve pressure rating and maximum differential pressure:	250 psi

1.8 DELIVERY, STORAGE AND HANDLING

- A. Refer to General Provisions for delivery, storage, and handling requirements.
- B. Onsite Storage Limitation: Onsite storage of surge tanks shall be limited to a maximum of two weeks, unless exception is approved by the City.
- C. Storage of the surge tank shall comply with manufacturer recommendations.

1.9 UNIT PRICES

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS.

- A. Accepted Manufacturer. The Hydropneumatic Surge Control System shall be as designed and manufactured by PULSCO, or an accepted equal.
- B. The Hydropneumatic Surge Control System shall include a surge tank and automatic level control system. The supplier must have experience, designing, supplying and starting up Hydropneumatic Surge Control Systems.
- C. Personnel representing the surge control system supplier are required to check the installation and instruct the owner's personnel in the operation of the surge control system. A field surge test may be performed in conjunction with this site visit.

2.2 SURGE TANK

- A. The vertical surge tank shall be 8-feet in diameter with a 4,500 gallon volume. The surge tank must have no moving parts, vanes or elastomers and shall contain a vortex breaker and differential nozzle (if required as determined from surge analysis).
- B. The Surge Tank shall be constructed of carbon steel for a Maximum Allowable Working Pressure (MAWP) of 300 psig in accordance with the ASME Pressure Vessel Code, Section VIII, Division 1. The minimum wall thickness shall be ¼ inch. The Surge Tank shall be provided with a flanged line connection (8-inch), adequate supports (two saddles for horizontal or four legs for vertical), lifting lugs and couplings for drain, safety relief valve and level control system. The Surge Tank shall be provided with an elliptical manway, minimum 14" x 18".
- C. Hydrostatic test the surge tank in accordance with ASME Code for Unfired Pressure Vessels. Form U-1A "Manufacturers' Data Report for Unfired Pressure Vessels" shall be provided by the surge tank manufacturer to certify that the surge tank was built in accordance with ASME Code Rules for the Construction of Unfired Pressure Vessels and inspected by a certified inspector.
- D. The internal surface of the surge tank shall be sandblasted to SSPC-SP-10 and apply NSF Standard 61 approved epoxy coating. Coating shall be applied in accordance with coating manufacturer's instructions.
- E. The external surface of the surge tank shall be sandblasted to SSPC-SP-6 and coated with a poly-urethane coating system with a zinc-rich primer. Final top coat color shall be selected by the City. Coating shall be applied in accordance with coating manufacturer's instructions.

2.3 LEVEL CONTROL SYSTEM

- A. The purpose of the level control system is to control the air volume in the surge tank. This is accomplished by maintaining the water level within a designed operating range.
- B. When water level is above the normal operating range, air shall be added to the surge tank from the air compressor, through the add air solenoid valve. When water is below the normal operating range, air shall be vented from the surge tank through the vent air solenoid valve. High and Low alarm signals shall be generated when the water level is out of range. Time delays shall be used to prevent false alarms and avoid adding or venting air during start up and shutdown or during minor fluctuations.
- C. The Automatic Level Control System includes Level Control Panel, Level Transmitter, Solenoid Valves and Air Compressor. In addition to the PLC control provided as part of the Surge Control system, integrate the surge tank control strategy into the local PLC and HMI.
 - 1. The PLC based level control panel shall be a PULSCO Skypark Series Control Panel or approved equal.
 - a. All electronics shall be housed in a 304 SS NEMA 4X enclosure.
 - b. Control panel shall be equipped with a door mounted 12" HMI touch screen display with a built in proximity sensor that will put the display to sleep if no movement is detected for several minutes.
 - c. HMI shall contain screens that have continuous indication of water level and corresponding tank water volume in real time that displays current water level in relation to solenoid and alarm level set points.
 - d. HMI shall contain screens that display and allow changes to current solenoid and alarm level set points and timers.
 - e. A button on the HMI shall be provided that resets all values to pre-programmed O&M values.
 - f. Vent and Add air solenoid control shall be selectable from hand, off, and auto from the panel display.
 - g. HMI shall contain an alarm screen that lists the alarms that have occurred and the number of occurrences that each alarm has had.
 - h. Control panel shall log and save locally all alarms and input signals for a minimum 3 months.
 - i. All field wiring to the panel shall be done through heavy duty connectors. There shall be no field wiring to components inside of the control panel.
 - j. Multiple heavy duty connectors shall be provided to separate AC and DC voltages.

- k. Electrical surge suppression devices shall be installed on all analog input signals.
 - l. Dry contacts shall be available for all alarm and solenoid relays.
 - m. Panel shall contain a managed Ethernet switch to allow Ethernet communication with site PLC or SCADA system.
2. Level Transmitter. Level transmitter provides a 4-20 mA signal and can be a Differential Pressure Transmitter, Magnetic Level Transmitter, or R.F Capacitance probe.
 3. Solenoid Valves. ASCO Redhat model or equal. One solenoid valve for adding air (lowering water level) and one solenoid valve for venting air (raising water level).
 4. Pneumatic Assembly. Solenoid valves and associated ball valves and piping shall be pre-assembled by the surge tank supplier and installed in a NEMA 4 enclosure with the Level Control Panel.
 5. Air Compressor. The air compressor package shall be a Simplex (one air-cooled, two-stage, oil lubricated reciprocating type air compressor mounted on one air receiver) or a Duplex (two air-cooled, two-stage, oil lubricated reciprocating type air compressors mounted on one air receiver). Air Compressor(s) shall include all necessary piping (tubing) for connection to the air receiver and all components wired to the air compressor control panel. The air compressor package shall be the standard product of a manufacturer who is regularly engaged in the design and construction of fully automatic air compressor systems. The air compressor system shall include the following items.
 - a. A Totally Enclosed Fan Cooled (TEFC) motor shall drive the compressor and shall be adequate to drive the compressor continuously at full-rated output. Power supply shall be 460 volts, 3 phase and 60 hertz. Coordinate motor Hp size with the electrical service.
 - b. The Hydropneumatic Surge Control System supplier shall select the compressor volumetric capacity and discharge pressure. The capacity and discharge pressure selected shall be sufficient for the application to adjust the fluid level from the add air level to the add air reset in no more than 20 minutes.
 - c. Compressor unit shall include a totally enclosed crankcase of cast iron, separate detachable deep finned cylinders, matched balanced pistons, separately removable valve housing, low oil switch and a direct reading pressure gauge. The low oil switch shall shut down the compressor if the oil level is too low. The switch shall not reset without adding oil.
 - d. The air compressor control panel shall be provided with a power on light, Hand-Off-Automatic (HOA) switch, run light, motor overload alarm light and low oil level alarm light. The panel shall contain combination magnetic motor starter and circuit breaker.

- e. The air compressor shall start and stop based on pressure in the air receiver. Dry contacts shall be provided in the panel for remote indication of running conditions for the compressor. The compressor shall be shutdown by motor overload, or low oil level. An alarm condition shall energize a local alarm light.
- f. The compressor shall start automatically, provided its HOA switch is in the AUTO position. The compressor shall run continuously if its HOA switch is in the HAND position and shall shut down if its HOA switch is in the OFF position.
- g. The air receiver shall be a minimum of 80-gallon capacity.
- h. The air compressor package shall be coated with the standard factory coating.

2.4 MISCELLANEOUS COMPONENTS

- A. $\frac{3}{4}$ " Safety Relief Valve. The surge tank shall have a safety valve sized in accordance with the ASME code to prevent over pressurizing the surge tank above its design pressure. Safety Relief Valve setpoint shall be set to the maximum allowable working pressure of the surge tank.
 - 1. Valves shall be of the spring-actuated type with an external lifting lever. Valve shall close when pressure drops to allowable range. Valve size shall not be less than that required to maintain the hydropneumatic tank at its ASME design pressure while the air compressor is discharging at that pressure. Bodies (including caps, bases, and bonnets) shall be bronze (ASTM B 61 or B 62) or Type 304 or 316 stainless steel with bottom inlet and side outlet. Inlet shall have male threads, ANSI B1.20.1. Discs and springs shall be Type 304, 316, or 420 stainless steel. Valve shall incorporate a calibrated spring set to allow the valve to open at a pressure of 300-psi. Valve shall be Kunkle Model 6283 EDM, or equal.
- B. Check valve for air line.
- C. Quick Air Fill Valve – Add 1-inch Chicago-style fitting per the Plans for quick/remote filling of tank.
- D. A valve shall be installed on the top of the tank to prevent fluid from ever being able to enter the air piping.
- E. Ball valves for isolation and bypass of solenoid valves, isolation and drain of the probe well and drain and isolation of the air piping.
- F. Instrument/Probe Well – 316 Stainless steel chamber with couplings for connection to surge tank and installation of level transmitter, level indicator and drain valve to allow for easy troubleshooting of the system.
- G. Level Gauge Assembly - A level indicator shall be mounted on the instrument well for visually checking surge tank water level. The indicator's connections shall have isolation valves. Indicator shall extend from approximately 6" below and 6" above the designed operating range.
- H. Air Muffler for reducing the noise generated from the venting of air from the Surge Tank.

- I. Pressure Gauge for indicating pressure in surge tank, 4 ½" diameter dial, ¼" bottom connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The system supplier shall provide all components and assembly instructions to the Contractor for installation.
- B. All piping, fittings, and interconnecting of components to be supplied and installed by the Contractor.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing, mechanical and electrical code requirements
- D. Welding shall comply with AWS Code requirements and the ASME Boiler and Pressure Vessel Code Section VII.
- E. Weld shell attachments to tank shell before applying coatings.
- F. Alarm and solenoid set points shall be marked on the probe well by horizontal lines or grooves about 1-inch long.

3.2 PERFORMANCE GUARANTEE

- A. The manufacturer shall provide a guarantee of performance and workmanship certifying that the system will meet all provisions of these specifications.

3.3 UNIT RESPONSIBILITY

- A. The Hydropneumatic Surge Control System shall be designed and supplied by a single manufacturer.
- B. Installation of the Hydropneumatic Surge Control System shall be the responsibility of the General Contractor.

3.4 FIELD QUALITY CONTROL AND TESTING

- A. Testing shall be performed by the Contractor in the presence of the Engineer and a representative of the supplier. Testing shall consist of functional test of the level control system and shall include a simulated power failure when pump(s) are running at maximum operating flow conditions. Start with power failure with one pump running. Then operate with power failure for two pumps running. Continue testing in increments until the surge control system has been demonstrated to control surge with power failure and all pumps running. Install pressure detectors and a strip chart recorder to record the pressures in the system upon commencement of power failure. Locate the detectors to cover the critical high pressure and low pressure surges.

- B. Adjust water level add-air and vent-air controls to specified settings. Check the ability of these controls to restore proper water level with normal pressure variations in the hydropneumatic tank.
 - 1. The compressor fill and air bleed controls shall be used together with the daily changing hydro-pneumatic tank levels. If the water level at max pressure (pump shut down) exceeds the target normal high water level, then the compressor will add air, if the water level at minimum pressure (pump start) is below the target normal low water level, then the air bleed valve will remove air. So pumps will operate off pressure set-points and the compressor and bleed valve will operate off both pressure and water level.
 - 2. Per the Surge Analysis, a time delay (dead-band) of 10 minutes shall be built into the control loop before operation of the compressor or bleed valve is triggered to preclude them from activating during a surge event which will push the tank air/water level beyond their normal setpoints.
- C. Contractor shall provide services of the System supplier representative on-site for at least 2 (two) man-days (travel time excluded) to provide:
 - 1. Installation assistance and inspection of complete surge tank system.
 - 2. Field testing, adjustment of surge tank control operations, and training.
 - 3. Instruction of City's personnel in operation and maintenance of surge tank system including compressed air system, electrical control system, and level control system.

3.5 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****

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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 11030 Variable Speed Drives, General
- 2. 11033 Variable Frequency Drives

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

- A. The following shall be submitted in compliance with Section 01300:
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, Vertical Hollow Shaft high thrust enclosure, 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, 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
- 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 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****

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SECTION 16640

CATHODIC PROTECTION SYSTEM

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide a cathodic protection system for the metallic (ferrous) yard piping at the Soledad Pump Station, including electrical connections, anodes, test stations, and all accessories required for a complete and operable system, including testing the system after installation, in accordance with the Contract Documents.
- B. The CONTRACTOR shall retain a NACE International-Certified Cathodic Protection Specialist to direct the construction of facilities specified herein. The Cathodic Protection Specialist shall test and certify that the corrosion control facilities for this Project are constructed properly and as specified, and are fully functional.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02200 Earthwork
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 03300 Cast-in-Place Structural Concrete
 - 4. Section 03315 Grout
 - 5. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:
 - 1. ASTM A497 Steel Welded Wire Fabric, Deformed, for Concrete Locator Code
 - 2. ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 3. ASTM B418 Cast and Wrought Galvanic Zinc Anodes
 - 4. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 5. NACE SP0169 Standard Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
 - 6. NEMA WC3 Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

- | | | |
|-----|----------|---|
| 7. | NEMA TC3 | PVC Fittings for Use with Rigid PVC Conduit and Tubing |
| 8. | NEMA WC5 | Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1985) |
| 9. | NEMA WC7 | Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy |
| 10. | NFPA 70 | National Electrical Code (NEC) |

1.4 DEFINITIONS

- A. Ferrous Metal Pipe: Pipe made of steel or iron and pipe containing steel or iron as a principle structural material, except reinforced concrete.
- B. Lead, Lead Wires, Joint Bonds, Cable: Insulated copper conductor; the same as wire.
- C. Foreign-Owned: Buried pipe or structure not specifically owned or operated by the OWNER.
- D. Electrically Continuous Pipeline: A pipeline that has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable bond resistance for each joint as specified in this Section.
- E. Electrical Isolation: The condition of being electrically isolated from other metallic structures (including, but not limited to, piping, reinforcement, and casings) and the environment, as defined in NACE Standard Recommended Practice SP0169.

1.5 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish the following documents in accordance with Section 01300, Submittals:
 - 1. Catalog cuts and other information for products to be used.
- B. Certifications: The CONTRACTOR shall submit a notarized affidavit of compliance that all Work, materials, and equipment required according to this Section were properly constructed and manufactured in full conformance with these Contract Documents. The CONTRACTOR shall submit the manufacturers' Certificates of Compliance.
- C. Anode Current Measurements: The CONTRACTOR shall tabulate and submit all structure-to-soil and anode current measurements, including the date of the measurement and the test location.
- D. Qualifications: The CONTRACTOR shall submit documentation of the qualifications of the Cathodic Protection Specialist.
- E. Record Documents: The CONTRACTOR shall submit Record Documents in accordance with the City of San Diego Whitebook and these specifications.

1.6 PACKAGING AND SHIPPING

- A. The CONTRACTOR shall coil wires and secure and package anodes, as required to prevent damage during shipment.

PART 2 -- PRODUCTS

2.1 CONDUIT, FITTINGS, AND ACCESSORIES

- A. Rigid and Flexible Conduit and Fittings: In accordance with Sections 16050, Basic Electrical Materials and Methods.
- B. Wire conduits shall consist of 2" diameter schedule 80 PVC in accordance with ASTM D1785.

2.2 GALVANIC ANODES

- A. Zinc Anodes:
 - 1. Composition: ASTM B418, Type II.
 - 2. Dimensions:
 - a. Length: 45 inches minimum.
 - b. Bare Weight: 45 pounds minimum.
- B. Anode Wire: Provide each anode with 10 AWG stranded copper wire with HMWPE insulation. Each wire will be of adequate length to extend to the test station traffic box without splicing.
- C. Wire-to-Anode Connection: Manufacturer's standard. The anode connection shall be stronger than the wire.
- D. Backfill: The anodes shall be prepackaged in a cloth bag containing backfill of the following composition:
 - 1. Composition:
 - a. Ground Hydrated Gypsum: 50%
 - b. Powdered Wyoming Bentonite: 50%
 - 2. Grain Size: 100 percent passing through a 20-mesh screen, and 50% retained by a 100-mesh screen.
 - 3. Mixture: Thoroughly mixed and firmly packaged around the galvanic anode within the cloth bag or cardboard tube by means of adequate vibration.
 - 4. The quantity of backfill shall be sufficient to cover surfaces of the anode to a depth of 1 inch.

2.3 WIRES

- A. General: Conform to applicable requirements of NEMA WC5 and NEMA WC7. All wires shall be a single conductor, unless otherwise specified.
- B. Bond Station: 8 AWG stranded copper wire with 600-V HMWPE insulation.
- C. Test Station: 8 AWG stranded copper wire with 600-V HMWPE insulation.
- D. Galvanic Anode Connecting Wires: As specified for galvanic anodes above.
- E. Wire Identification:
 - 1. All wires shall be identified by 1-inch circular brass disks with stamped or engraved identifier. The letters and numbers shall be minimum 3/16-inch in size. Wire identifiers for anodes shall be the wrap around type with a high resistance to oils, solvents and mild acids. Marker shall fully encircle wire with imprinted alpha-numeric characters for pipe identification.

2.4 CATHODIC PROTECTION TEST STATIONS

- A. Flush Mounted:
 - 1. Test Box: Concrete box of dimensions shown on the Drawings. Provide extensions, as required, to penetrate concrete surfaces by 4 inches minimum. Provide a cast iron cover with the letters "CP TEST."
 - 2. Test Box Manufacturer and Product: Brooks, 36 series; Christy, Model B9; or equal.

2.5 SHUNTS

- A. Holloway Type SW, 0.100-ohm (50 mVolts = 0.500 Amps).

2.6 CONCRETE

- A. Reinforcing steel: ASTM A615, Grade 60 deformed bars and welded wire fabric per ASTM A497 and in accordance with the requirements of Section 03200, Reinforcement Steel.
- B. Welded Wire Fabric: ASTM A497.
- C. Formwork: Plywood, earth cuts may be used.
- D. Concrete Design for Minimum Compressive Strength at 28 Days: 3000 psi, in accordance with the requirements of Section 03300, Cast-in-Place Concrete.

2.7 WARNING TAPE

- A. Inert polyethylene that is impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
- B. Thickness: Minimum 4-mils.

- C. Width: 12-inches.
- D. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
- E. Manufacturers, or equal:
 - 1. Reef Industries; Terra Tape.
 - 2. Allen; Markline.
- F. Color: Red with black lettering as follows: "ELECTRICAL WIRES BURIED BELOW."

2.8 ALUMINO-THERMIC WELDS

- A. Exothermic weld material shall be a mixture of copper oxide and aluminum, packaged by size in individual plastic containers for each weld connection. The weld materials shall be non-explosive and not subject to spontaneous ignition.
- B. Exothermic weld material and accessories shall be Erico Products, Inc., ThermOweld® or equal. Materials from different manufacturers shall not be mixed.
- C. Any exothermic weld connections made on pipelines internally lined with epoxy or polyurethane materials shall be made by limiting the weld charge and weld location to avoid damaging the pipeline's internal lining. For example, where possible make an exothermic weld connection to a pipe flange instead of directly on the pipe cylinder, or connect to the pipe at crotch plates, or perform the exothermic welds with the pipeline full of water. For new steel pipeline projects with non-cementitious linings consider special ordering steel pipe manufactured with thickened steel plates near pipe joints to dissipate the heat from exothermic welding.
- D. Unless specifically prohibited in the project drawings, pin brazing is an acceptable alternative to alumino-thermic welded connections of copper wire to steel pipe. The threaded stud style of pin brazed connections shall not be used for wire to pipe connections that will be buried, submerged, or concrete encased. The threaded stud style of pin brazed connections shall only be used inside vaults, on above ground piping, and other similar areas that will be accessible in the future for periodic visual inspection. All pin brazed copper wire to steel pipe connections that will be buried, submerged, or concrete encased shall be made by first crimping a copper alloy cable lug to the copper wire using a tool specifically designated for crimping electrical lugs, then soldering the connection between the copper wire and crimped copper alloy lug, and then attaching the copper lug to the steel pipe using appropriately sized brazing pins and ferrules per the pin brazing equipment manufacturer's instructions.

2.9 WELD COATING

- A. Liquid applied coatings for all CP wire welds shall have a minimum solids composition of 80%. Acceptable exothermic weld coatings include the following products. Other coatings may be submitted for approval as long as they are compatible with the surrounding coating, have a sufficiently fast cure to not interfere with the pipe backfilling process, and comply with California volatile organic content regulations.
 - 1. ProtectoWrap JS160H Mastic.
 - 2. Protal 7200 Repair Cartridge, 100% solids fast cure epoxy repair coating, handling time

at 70 degrees Fahrenheit is 3 hours.

3. Protal 7125 Repair Cartridge, 100% solids fast cure epoxy repair coating, handling time at 70 degrees Fahrenheit is 30 minutes.
4. Weld coatings for pipelines to be buried shall be chosen with a cure time appropriate for the time restrictions required to backfill the pipeline after the CP wire connections have been made to the pipe.

- B. Viscous-Elastic Polyolefin Patch Alternative - An acceptable alternative to a liquid applied coating for exothermic welds is a patch consisting of a non-crystalline, a-polar viscous elastic, 100% solids polyolefin material that protects against corrosion of underground and aboveground substrates. The material must remain flexible and pliable in a semi-solid state, contain no volatile organic compounds (VOCs), and it must have an immediate cure time with no stand by required before backfilling the pipeline. The material must be the Viscotaq patch manufactured by AMCORR or an approved equal.

2.10 PIPE FLANGE INSULATING KIT

- A. For purposes of this specification, the terms "Pipe Flange Insulating Kit", "Insulated Flange", "Insulated Joint", and "Dielectric Flange" are used synonymously.
- B. Pipe flange insulating kit materials shall be designated by the manufacturer as suitable for service at the operating temperatures and pressures specified on the Plans.
- C. Flange insulating kits shall consist of a one piece, full-face, insulating gasket, an insulating sleeve for each bolt, insulating washers, and steel washers. For nominal pipe diameters up to and including 36-inches, provide one insulating washer and one steel washer on each side of the flange for each flange bolt. For nominal pipe diameters greater than 36-inches, the insulating washers shall be installed sandwiched between a pair of matching steel washers on each side of the flange for each flange bolt.
- D. Insulating Gasket: Insulating gasket retainers shall be full face, Type E, NEMA G-10 glass reinforced epoxy retainers with an ethylene propylene diene Monomer (EPDM) rubber rectangular cross section O-ring seal. Minimum total gasket thickness shall not be less than 1/8-inch. The gasket shall have the same outside diameter as the pipe flange. For steel pipe the gasket's inside diameter shall be equal to the inside diameter of the pipe's steel cylinder. At valve to pipe connections where the inside diameters are not equal, the gasket's inside diameter shall be equal to the smaller of the two inside diameters. Dielectric strength shall be not less than 550-volts per mil, and compressive strength shall be not less than 50,000-psi. The manufacturer's name and date of manufacture shall be marked on both sides of the gasket with minimum two-inch tall block letters using a durable marking ink or paint. The gasket shall be installed within 12 months of its date of manufacture. Do not store insulated flange gaskets at jobsites under direct sunlight or at temperatures exceeding 110 degrees Fahrenheit. Use PSI Linebacker insulating gasket, or equal.
- E. Insulating Sleeves: Provide full length, one piece, NEMA G-10 glass reinforced epoxy insulating flange bolt sleeves. Dielectric strength shall be not less than 400-volts per mil. The length of the insulating sleeves shall provide an air gap between the end of the insulating sleeve and inside surface of the stud bolt nut with a tolerance of 1/32-inch minimum and 1/8-inch maximum. Insulating sleeve length must be adjusted for the actual thickness of the ASTM F436 washers and insulating washer thickness.
- F. Insulating Washers: Insulating washers shall be NEMA G-10 glass reinforced epoxy with a minimum thickness of 1/8-inch. Dielectric strength shall not be less than 550-volts per mil,

and compressive strength shall not be less than 50,000-psi. The insulating washer's inside diameter shall be sized to fit over the insulating sleeve's outside diameter.

- G. Steel Washers: Provide hardened steel washers that conform to ASTM F436 for insulated flanges greater than 36 inches in nominal diameter. Double steel washers (4 steel washers per flange bolt) are required for insulated flanges greater than 36 inches in nominal diameter. The inside and outside diameter of the steel washers shall match those of the insulating washers. The steel washers must be able to freely rotate around the insulating sleeve. Attention must be paid to the fit between the steel washers and the insulating sleeve in order to avoid the washers twisting and cracking the sleeves when the flange bolts are torqued.
- H. Provide four extra insulating sleeves and eight extra insulating washers for each insulating flange upon successful inspection of the insulating flange by the Engineer.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Construct cathodic protection system, electrical insulators, and test stations for buried and submerged steel structure and appurtenances.
- B. Conform to NFPA 70 and NACE SP0169.
- C. Provide metering facilities as required by electric utility for utility's installation of metering equipment, service conductors, and mounting of utility company equipment.

3.2 ANODE INSTALLATION

- A. Prepackaged anodes shall be installed at the locations indicated. Plastic or paper wrap shall be removed from the anode before lowering the anode into the hole. Anodes shall not be suspended by the lead wires. When compacted soil is required and has been placed to the top of the anode and before the filling of the hole with soil, a minimum of ten gallons of water shall be poured into the hole to saturate the anode backfill and surrounding soil.
 - 1. Backfilling with native soil shall proceed in 6-inch lifts, compacting the soil around the anode during each lift, until the backfill has reached grade, in accordance with the requirements of Section 02200, Earthwork. Damage to the canvas bag, anode to wire connection, copper wire, or wire insulation shall require replacement of entire assembly.
 - 2. Anodes shall not be backfilled before inspection and approval of the CONSTRUCTION MANAGER.

3.3 CP TEST STATION WIRE INTEGRITY TESTING

- A. Testing of Completed Welds: Exothermically welded wire-to-pipeline connections shall be inspected by the Engineer prior to backfilling the pipeline. At the Engineer's direction, tests to verify the soundness of the welds shall be conducted by the Contractor. Tests for this purpose shall consist of striking the weld nugget with a 2-pound hammer while steadily pulling on the wire. Note that the wire near the weld shall not be unnecessarily cold worked during installation or testing. Remove and re-weld any welds that break loose or show signs of separating, as determined by the Engineer.

- B. Wire Identification: The Engineer shall be given two day's advance notice to verify that buried pipe lead wires and anode lead wires are properly identified with die stamped brass or stainless steel tags prior to backfilling the wires.
- C. CP Test Wire Resistance Tests: After the pipeline is backfilled and the CP test wires are trenched to the CP Test Box or CP Monitoring Station, each pair of CP test wires shall be tested for integrity. The CP Technician shall measure the electrical resistance of one CP test wire to the pipeline and back on the second CP test wire. If more than twice the theoretical resistance of the total wire length installed is measured, the Contractor shall reexcavate the pipeline and replace or reweld the CP test wires to the pipeline. Use the following copper wire unit resistance values to calculate the theoretical resistance of each pair of CP test wires.
 - 1. No. 4 AWG wire 0.258 Ohms / 1000 feet
 - 2. No. 6 AWG wire 0.411 Ohms / 1000 feet
 - 3. No. 8 AWG wire 0.653 Ohms / 1000 feet
 - 4. No. 10 AWG wire 1.038 Ohms / 1000 feet
 - 5. No. 12 AWG wire 1.650 Ohms / 1000 feet
 - 6. No. 14 AWG wire 2.525 Ohms / 1000 feet

3.4 CONCRETE

- A. Place concrete in accordance with the requirements of Section 03300, Cast-in-Place Concrete.

3.5 CONDUCTOR INSTALLATION

- A. Conductors: Install and pull conductors in accordance with the requirements of Section 16050, Basic Electrical Materials and Methods.
- B. Below ground Seals: Seal below ground conduit to prevent intrusion of foreign material after wires are in place.
- C. Direct Buried Wires: Direct buried galvanic anode wires shall be 36-inches deep, minimum, below finished grade. Wires shall be free of splices.
- D. Warning Tape: Bury warning tape approximately 12-inches above underground rectifier conductors and conduits. Align parallel to and within 2-inches of the centerline of the conduit or conductor run.

3.6 BOND STATION WIRES

- A. Install bond station wires, as shown on the Drawings.

3.7 CONDUITS

- A. Securing Conduits: Secure conduits entering test station boxes with double locknuts, one on the outside and one on the inside.

- B. Insulation Fittings: Install insulated bushings and insulated throat connectors on the ends of rigid metallic conduit.
- C. Watertight Fittings: Use watertight couplings and connections. Install and equip boxes and fittings to prevent water from entering the conduit or box. Seal unused openings.

3.8 TEST STATION INSTALLATION

- A. Locations: Determine the location of the test stations based on actual site conditions and as approved by the CONSTRUCTION MANAGER.
- B. Wire Attachment: Attach test wires to the pipe at joints and before coating joints.
- C. Wire Connections: Make wire connections to test station terminals with crimp-on spade lug terminals, except where solid wire is specified or terminal strips with tubular clamps are used.
- D. Wire Identifiers: Install wire identifiers on all conductors in boxes. All materials used shall be suitable for permanent identification. Paper or cloth markers will not be permitted. Position all markers in boxes so that they do not interfere with operation and maintenance. Labels to be marked as shown in the table.

Wire Identification Label Requirements		
Wire Connection	Wire Color & Size	Label Marking
Pipe Test	White 8 AWG	PIPE
Galvanic Anode	Black 10 AWG	ANODE
Protected Pipe at Insulator	White 8 & 12 AWG	PIPE-PROT
Unprotected Pipe at Insulator	Green 8 & 12 AWG	PIPE-UNPROT

3.9 EXOTHERMIC WELDS

- A. Make wire connections to the pipeline or other structure with an exothermic weld process ("Cadweld", "ThermOweld", or equal) per manufacturer's recommendations.
- B. Provide a minimum separation of 3-inches between multiple exothermic welds.
- C. Remove a minimum amount of the existing coating required for placement of the weld mold on the steel structure. The steel surface must be completely clean and dry (near white metal surface preparation).
- D. After the weld is made test it for proper strength by lightly striking it from the side with a small (e.g. 2-pound) hammer. If the weld comes off after lightly tapping it with a hammer, move away a minimum of 3-inches and repeat steps A through D.
- E. After testing, apply one of the specified weld coatings or weld patches.

3.10 WIRE-TO-PIPE CONNECTIONS ON BURIED PIPE

- A. Exothermically weld the CP test wires to pipelines at the nearest pipe joint to the pipeline

station indicated on the Plans.

- B. Install the wires with sufficient slack so that the wire insulation and copper conductors will not be damaged during the pipe backfilling process. Protect the wires by running them in schedule 40 PVC electrical conduit in all locations where the horizontal distance from the pipeline to the CP test box is more than 6 feet. Begin the PVC conduit within one foot of the welded wire connections to the pipe. Since HMWPE wire insulation is rated for direct burial the PVC pipe serves only for physical protection from excavation and the conduit does not need to have sealed ends or special fittings where the wire exits the end of the PVC conduit underground.
- C. For dielectrically coated steel pipelines, coat the exothermically welded connection with one of the specified weld coatings in Section 1 of this specification.
- D. For cement mortar and concrete coated pipelines, cover the exothermic weld nugget and all disturbed areas of the pipeline coating with a quick cure, non-shrink, and cementitious, patching compound. Apply the compound to a thickness of 1-inch or more to match the surrounding pipe coating thickness, whichever is greater.
 - 1. The patching compound shall have a set time of less than 20 minutes, a maximum shrinkage of 0.087 percent after seven days (ASTM C 596 test method), achieve a minimum compressive strength of 3,570-PSI in one day, and a minimum compressive strength of 6000-PSI in 28 days (ASTM C109).
 - 2. Use "RapidSet Cement All" as manufactured by CTS Cement or "Jet Set Complete Repair" as manufactured by Jet Set Cement Corporation or an approved equal quick setting cement.

3.11 WIRE-TO-PIPE CONNECTIONS INSIDE VAULTS OR TO ABOVE GRADE PIPE

- A. For wire-to-pipe connections inside vaults and other structures, exothermically weld the CP test wires to the pipe within 1-foot of the pipe-wall penetration, on the interior side. The welded connections shall be positioned so that the wires do not interfere with the installation or removal of nearby pipe flange bolts.
- B. Paint the exothermically welded connection with a coating that matches the type of coating and color of the pipe coating used within the vault. If no coating is being applied to the pipe within the vault coat the wire to pipe connections with a black epoxy paint.

3.12 INSTALLATION OF INSULATING FLANGE MATERIALS

- A. Provide a minimum of five days advance notice to the Engineer before assembling insulated pipe flanges 60 inches or larger in diameter to allow for coordination and observance of its installation. The Engineer shall inspect the condition of the gasket's O-ring immediately before the gasket is installed to ensure it is free of cracks, dry rot, cuts, or other defects.
- B. Install pipe flange insulating materials at the locations shown on the Plans. Install pipe flange insulating materials in accordance with the manufacturer's recommendations and NACE recommended practice RP0286, "Electrical Isolation of Cathodically Protected Pipelines." Particular attention shall be paid to properly aligning the flanges prior to inserting the insulating sleeves around flange bolts. Prevent moisture, soil, or other foreign matter from contacting any portion of the insulated flange prior to or during installation. If moisture, soil, or other foreign matter contacts any portion of the insulated flange, disassemble it, clean with a suitable solvent and dry prior to reassembling. Follow the manufacturer's recommendations regarding the torquing pattern of the bolts and the amount of torque to be used when installing the flange

insulating kit. Do not use conductive grease on the flange bolts or any other flange components. Note: the following products have been tested for electrical conductivity and approved for use: Huskey 2000 Lubricating Paste & Anti-Seize compound, 3M Super 77 Spray Adhesive, and Triflow aerosol lubricant with Teflon additive.

3.13 WARNING TAPE INSTALLATION

- A. Install warning tape along the centerline of horizontal runs of the wire.

3.14 TESTS AND INSPECTION

- A. Test Equipment: Before construction begins, obtain the test equipment necessary for electrical continuity testing and the following equipment:

1. Model 601 Insulation Checker, as manufactured by Gas Electronics Co., Seymour, MO, or equal.
2. A Model HD-100, Digital Multimeter, with case and test leads, as manufactured by Beckman Instruments, San Diego, CA, or equal.

- B. Store test equipment at the Construction Site and maintain in accurately calibrated, working condition. The test equipment shall be available to the CONSTRUCTION MANAGER for testing purposes. Upon completion of the Project, the test equipment listed above shall be turned over to the OWNER in clean, accurate, and fully functional condition, along with operating manuals, test wires, and cases supplied with the equipment.

- C. Electrical Continuity Testing of Pipe with Bonded Joints:

1. Conduct electrical continuity testing to demonstrate that all buried pipe joints (except insulated flanges) are either welded joints or have been electrically bonded across with No. 2 AWG stranded copper bond cables. This testing shall be performed by the Contractor's Cathodic Protection Technician and witnessed by the Engineer. The Contractor shall demonstrate to the Engineer's satisfaction that full electrical continuity has been achieved and shall make all required bond cable connections in the event that electrical continuity of the pipeline is not achieved.
2. Perform electrical continuity tests at maximum spacings of 1000-feet of pipe. Circulate a 12-volt electrical direct current (DC) through the pipeline. Use two pairs of test wires, one for current flow, one for voltage measurement. Measure the voltage difference developed by the DC current flow. Calculate the electrical resistance of the pipeline section in Ohms using Ohm's Law.
3. The resistance acceptance criterion for each pipeline section tested is less than 150 percent of the calculated resistance value. The resistance value shall be calculated using the steel cross section area of the pipe, its length, and consideration for the joint bond cables at each bonded joint.
4. If other electrical continuity test methods are proposed, the Contractor shall prepare a written test procedure specifying the alternate method and equipment that will be used. A standard handheld digital multi-test meter's ohmmeter circuit (e.g. Fluke 87) is not suitable for properly making these electrical resistance measurements. Submit in writing the alternate proposed test method to the Engineer for approval a minimum of 30 days before the pipe laying begins.

D. Testing Insulated Pipe Flanges:

1. Test the electrical isolation effectiveness of each insulated pipe flange. This testing shall be performed by the Contractor's Cathodic Protection Technician and witnessed by the Engineer. The Contractor shall provide written notice of this testing to the Engineer a minimum of two days in advance. If the insulated pipe flange will be buried, it shall be tested for electrical isolation by the Contractor before the wax tape coating is applied. At the Engineer's option, the City of San Diego may repeat this testing during or immediately after the installation of the insulating flange. Replace or repair any insulated pipe flange that is determined to not meet the minimum electrical isolation requirements in this specification. The effectiveness of insulating flanges shall be determined using the following test techniques in the order shown until one of the criteria is achieved or as otherwise directed by the Engineer.
 - a. Electrical Potential Difference Test: Electrically bond the pipe on the vault or unburied side of the insulating flange to an electrical ground with a maximum resistance to remote soil of 5-Ohms. If the pipe on both sides of the insulating flange is mechanically connected to a minimum 50-feet of buried pipe, then the pipe does not need to be bonded to an electrical ground for this test. Measure the CP Potential of the pipe on both sides of the insulating flange using a copper/copper sulfate reference electrode. If the difference in CP Potentials is greater than or equal to 500-millivolts, the insulating flange is providing adequate electrical isolation. This test must be performed with all cathodic protection systems and anodes disconnected from the pipeline. If this criterion is not met, perform the Nilsson 400 Meter Direct Resistance Test to verify the effectiveness of the insulating flange.
 - b. Direct Resistance Test: Measure the electrical resistance across the insulated flange using a 97-Hertz square wave null balancing ohmmeter such as the Model 400 Nilsson Soil Resistance Meter and the four-wire resistance technique. A standard handheld digital multi-test meter's ohmmeter circuit (e.g. Fluke 97 or Beckman HD110) is not suitable for properly making these resistance measurements. Perform this test by connecting the meter's P1 and C1 terminals to one side of the insulating flange, using two wires, and then connecting the meter's P2 and C2 terminals to the other side of the insulating flange, using two additional wires. Use vise grips or temporary exothermic welds to make the wire connections to the flange or pipe. The criterion for a pipe filled with water is a minimum measurement of 5-Ohms. The criterion for a dry or a partially filled pipe is a minimum measurement of 100-Ohms. If none of the applicable criteria are met, perform the Inductive Ammeter Direct Resistance Test to verify the effectiveness of the insulating flange.
 - c. Inductive Ammeter Direct Resistance Test: Connect two separate wires via two separate connections to the pipe on both sides of the insulating flange. Use vise grips or temporary exothermic welds to make the wire connections. Use two pairs of test wires, one for current flow, one for voltage measurement. Using the first set of test wires, apply a minimum 12-volt DC electrical current across the insulating flange. Using the second set of test wires, measure the voltage across the insulating flange developed by the DC current flow. Use an inductive ammeter hoop (e.g. Swain hoop) clamped around the pipe immediately adjacent to the insulating flange to measure the change in DC current flow in the pipe, through the insulated flange. Calculate the electrical resistance across the insulating flange in Ohms by dividing the change in DC Volts by the change in DC Amps (i.e. Ohm's Law). The criterion for a pipe filled with water is a minimum

measurement of 5-Ohms. The criterion for a dry pipe is a minimum measurement of 100-Ohms. If either of the applicable criteria is not met, perform the NACE Insulating Flange Leakage Test, per NACE RP0286, to verify the effectiveness of the insulating flange.

d. NACE Insulating Flange Leakage Test: This test procedure shall conform to the "Leakage Test" described in the NACE Standard RP 0286, Section 8, "Field Testing and Maintenance", Figure 12. The test current used shall be between 3 and 5 DC Amps. The criterion for a pipe filled with water is a maximum "electrical leakage value" of 10-percent of the test current. The criterion for a dry pipe is a maximum "electrical leakage value" of 5-percent of the test current.

2. Individual Flange Bolt Testing: For all insulated flanges to be buried and for all other insulating flanges that do not meet any of the other criteria, measure the electrical resistance of each flange bolt to both sides of the insulated flange using a Nilsson Model 400 Soil Resistance Meter and four-wire resistance technique. The measured resistance value for each flange through-bolt shall be a minimum of 1,000-Ohms, as measured from each bolt to both flanges. This criterion applies to the flange through-bolts and does not apply to valve cap bolts which are threaded on one side. Remove, inspect, and replace all dielectric flange bolt sleeves and washers that do not meet the minimum resistance criterion.
3. If an insulated flange with threaded cap bolts passes the resistance tests for all the "through-bolts" yet fails the other previous tests, remove all the threaded cap bolts, inspect and replace all imperfect dielectric flange bolt sleeve and washer materials and retest.
4. In order to make an accurate resistance measurement that passes any of these criteria it may be necessary to disable the pipe inside a vault, flow control facility, or pump station on one side of the insulated flange (or temporarily remove any electrically grounded appurtenances) so that the pipe is not grounded on one side of the insulated flange. This temporary change may eliminate an electrical path which interferes with making an accurate resistance measurement.

E. Acceptance Criterion for Steel Pipe with Dielectric Coating:

1. The operation of the cathodic protection system for steel pipelines with a dielectric coating shall be tested to ensure that all portions of the buried pipeline are provided a full level of corrosion protection. The standard used to evaluate the CP potential measurements shall be as follows 0.85-VOLT CP Instant Off POTENTIAL - A negative voltage of at least 0.85-volt as measured between the buried pipeline and a copper sulfate reference electrode contacting the soil immediately over or adjacent to the pipeline in accordance with NACE SP0169. Determination of this voltage is to be made with the cathodic protection current momentarily interrupted. Voltage drops must be considered for valid interpretation of this voltage measurement.

F. Acceptance Criterion for Steel Pipe Without Dielectric Coating:

1. The operation of the cathodic protection system for pipeline's that do not have a dielectric coating (such as concrete coated steel pipe) shall be tested to ensure that all portions of the buried pipeline are provided a full level of corrosion protection. The standards used to evaluate the CP potential measurements shall be in accordance with either of the two following NACE SP0169 criteria.
 - a. 0.85-VOLT CP ON POTENTIAL - A negative voltage of at least 0.85-volt as

measured between the buried pipeline and a copper sulfate reference electrode contacting the soil immediately over or adjacent to the pipeline. Determination of this voltage is to be made with the cathodic protection current applied. Voltage drops must be considered for valid interpretation of this voltage measurement. To avoid anode gradient voltage drop errors (i.e. IR Drop error), CP On Potential measurements shall only be used at locations greater than 20-feet away from any galvanic anodes and greater than 200-feet away from any impressed current anodes. For locations closer to anode installations, use CP Instant Off Potential measurements by interrupting the CP current(s).

- b. 100-mV CP POLARIZATION SHIFT - A minimum polarization shift of 100-millivolts measured between the buried pipeline being protected from corrosion and a copper sulfate reference electrode contacting the soil immediately over or next to the pipeline. This minimum polarization shift shall be determined by interrupting all cathodic protection currents and measuring the polarization formation or decay. At the instant the cathodic protection current is interrupted ("instant off"), an immediate voltage shift will occur. The voltage reading just after the immediate shift shall be used as the base reading from which to calculate the polarization formation or decay.
- G. Functional Testing: The CONTRACTOR's Cathodic Protection Specialist shall perform tests to ensure proper installation and operation of the cathodic protection system. These tests shall consist of the following:
1. Structure-to-Soil Potential Measurements: Measure the structure-to-soil potential of the pipeline at each test station using the equipment specified herein. Structure-to-soil potential measurements shall be made at the surface with a portable copper-copper sulfate reference electrode. Structure-to-soil potential measurements shall be made at the following intervals.
 - a. Before the galvanic anodes are connected to the pipe at the test stations (native potential).
 - b. One week, 1 month, and 6 months after the galvanic anodes are connected to the pipe at the test stations or the rectifiers are energized (polarized potential).
 2. Structure-to-soil potential measurements shall be taken on all wires at each location and recorded.
 3. Anode Current Measurements: Measure and record the anode current at each test station using the specified shunts. Measure the anode current at the same time as the structure-to-soil potential measurements are taken (1 week, 1 month, and 6 months after the galvanic anodes are connected to the pipe).
 4. Additional Testing: The CONTRACTOR shall perform additional measurements, as required, to locate shorts or other cathodic protection system deficiencies.

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SECTION 230000

GENERAL MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. The General conditions, supplementary conditions, special Requirements, and applicable portions of Division 1 of the specification are a part of this Division and the requirements contained herein are supplementary to them.
- B. This Division is an integrated whole comprising interrelated and interdependent sections and shall be considered in its entirety in determining requirements.
- C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.2 ABBREVIATIONS AND DEFINITIONS (as used on Division 23 Drawings and herein)

- A. This Division is abbreviated and includes incomplete sentences. Supply omitted words by inference.
- B. Symbols: "[S]" means submittals are required; "[M/O]" means Maintenance/Operating data is required; see paragraphs hereinafter.
- C. "Provide" means furnish, install and connect unless otherwise described in specific instances.
- D. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.
- E. "Ductwork" means ducts, plenums, compartments, casings or any like devices, including the building structure, which are used to convey or contain air.
- F. "Extend", "Submit", "Repair", "Abandon", "Replace", "Remove" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.
- G. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constructed authorities and public utility franchise holders having jurisdiction.
- H. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.
- I. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces which are not included in the utility areas definition.
- J. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.
- K. "Below Grade" means buried in the ground.
- L. "Substantial Mechanical Completion" means all components of all systems are functioning but lacking in final adjustment.
- M. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid which the device will serve.

1.3 DESCRIPTION

- A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.4 RELATED WORK

- A. Coordination: Refer to Architectural, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for

the correct placing and connection of mechanical work in relation to the work of other Divisions.

- B. Examine other Divisions for work related to the work of this Division especially Division 26 - ELECTRICAL.

1.5 EXISTING CONDITIONS

- A. Visit the site prior to bidding and investigate the existing conditions which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the forgoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.
- B. The location of existing concealed utility lines are shown in accordance with reference data received by the Resident Engineer. The Resident Engineer does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his bid to cover costs of connection regardless of their exact location.
- C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.

1.6 DRAWINGS AND SPECIFICATIONS

- A. Drawings and specifications are intended to complement each other. Where a conflict exists between the requirements of the drawings and/or the specifications, request clarification.
- B. The Resident Engineer shall interpret the drawings and the specifications, and his decision as to the true intent and meaning thereof and the quality, quantity, and sufficiency of the materials and workmanship furnished there under shall be accepted as final and conclusive.
- C. In case of conflict not clarified prior to Bidding deadline, use the most costly alternative (better quality, greater quantity, or larger size) in preparing the Bid. A clarification will be issued to the successful bidder as soon as feasible after the Award and if appropriate a deductive change order will be issued.
- D. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option."

1.7 PERMITS AND INSPECTIONS

- A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.
- B. Afford the Resident Engineer's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.8 CODES AND REGULATIONS

- A. By submitting a bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract documents and the Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Resident Engineer in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specify references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options which are permitted by Codes.
- B. Applicable Codes: (Current editions unless otherwise noted)
 - 1. All local codes; city and/or County as applicable
 - 2. OSHA requirements
 - 3. Uniform Building Code
 - 4. Uniform Mechanical Code
 - 5. Uniform Plumbing Code
 - 6. California Code of Regulations (CCR) Titles
 - 7. Fire Marshal Regulations
 - 8. Regulations of all other authorities having jurisdiction
- C. Where conflict or variation exists among codes, the most stringent shall govern.
- D. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", "equal or exceed the services and performance of the specified material". Simply state that the product conforms to the requirements specified.
- E. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.
- F. Factory Tests: Factory tests are tests which are required to be performed on the actual materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.
- G. Permits and Certificates of Inspection: Furnish the originals.
- H. Testing procedures and test results required in this and other sections. Furnish 2 copies.
- I. Other data required by other sections of this Division. Furnish 2 copies.

1.9 RECORD AND DOCUMENTATION

- A. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work:
 - 1. Record (As-Built) Drawings:
 - a. Maintain in good order in the field office a complete set of prints for all work being done under Division 23. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.

- b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
 - c. Furnish the originals.
2. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. Seven copies of the manual, bound in hardback binders or an approved equivalent, shall be provided to the Resident Engineer in accordance with the Division 1 section on Maintenance and Operation Manuals. Furnish one complete manual prior to the time that system or equipment tests are performed. Furnish the remaining manuals before the contract is completed. The following identification shall be inscribed on the cover:

OPERATION AND MAINTENANCE MANUAL
 PROJECT TITLE.....
 CONTRACTOR.....

Provide a table of contents. Insert tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:

- a. Updated approved materials list, shop drawings and catalog information of all items indicated by symbol "[M/O]" at titles or beginning of paragraphs.
- b. System layout showing piping, valves and controls.
- c. Wiring and control diagrams with data to explain detailed operation and control of each component.
- d. A control sequence describing start-up, operation and shutdown.
- e. Detailed description of the function of each principal component of the system.
- f. Procedure for starting.
- g. Procedure for operation.
- h. Shut-down instruction.
- i. Installation instructions.
- j. Adjustments, maintenance and overhaul instructions.
- k. Lubrication schedule including type, grade, temperature range and frequency.
- l. Safety precautions, diagrams and illustrations.
- m. Test procedures.
- n. Performance data.
- o. Parts lists, with manufacturer's names and catalog numbers.
- p. Preventive maintenance schedule.
- q. Service organization with name, address and telephone number.
- r. Valve identification chart and schedule.
- s. ASME certification
- t. Air Balance report.
- u. Hydronic Balance report.

- B. Standard Compliance: Where equipment or materials are specified to conform with requirements of standards of recognized technical or industrial organizations such as American National Standards (ANSI), American Society of Mechanical Engineers (ASME), American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), Underwriters Laboratories (UL), American Refrigeration Institute (ARI), American Gas Association (AGA), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

- C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", "equal or exceed the services and performance of the specified material". Simply state that the product conforms to the requirements specified.
- D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.
- E. Factory Tests: Factory tests are tests which are required to be performed on the actual materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.
- F. Permits and Certificates of Inspection: Furnish the originals.
- G. Testing procedures and test results required in this and other sections. Furnish 2 copies.
- H. Other data required by other sections of this Division. Furnish 2 copies.

1.10 TOOLS

- A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.11 CONSTRUCTION COST BREAKDOWN

- A. To assist the Resident Engineer and Engineer in evaluation of the construction cost, the Contractor shall prepare and submit for review a construction cost breakdown for the major subdivisions of the mechanical work.
- B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.
- C. Cost breakdowns shall be submitted and approved prior to the first payment request. Send one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer. Each major component of equipment shall have manufacturer's name, address, model, and

serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

- B. Whenever on the plans, or in these specifications, products are identified by the name of one manufacturer, it is intended that equivalent products of other manufacturers are acceptable, unless otherwise indicated, if accepted as a substitution by the Resident Engineer. Where three or more manufacturers are listed as "acceptable manufacturers" however, then the products furnished shall be the product of one of the manufacturers listed. Manufacturers listed as "acceptable manufacturers" shall meet quality and performance of a particular one specified by both name and catalog number.

2.2 SUBSTITUTIONS

- A. General: Should the Contractor desire to substitute for specified products, he shall submit with the Material List a complete list of the requested substitutions. The request shall contain complete descriptive information of the products. Samples for evaluation shall also be submitted upon the Resident Engineer's request. If in the Resident Engineer's opinion the products as presented in this first submittal are in variance with the specified products, or if the information submitted is not sufficiently complete to allow proper evaluation, the substitution will be disallowed from consideration and the specified products shall be furnished. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any changes (whether architectural, structural, electrical or mechanical) necessary to accommodate the substitution.
- B. Specific: Refer to other sections of this Division for additional requirements.

2.3 SUBMITTALS

- A. General:
 - 1. Provide for all items indicated with the symbol "[S]" at titles or beginning of paragraphs in accordance with the Division 1 section covering submittals and as herein specified. Where warranty of longer than one year is specified, include such warranty with submittal. Resident Engineer's review of the submittal is only for general conformance with design compliance with the information given in the contract documents. The submittal procedure is required as an effort to minimize the problems which occur due to the discovery of Contractor non-compliance at the construction site. The Contractor is responsible for conformation and correlation of the dimensions, quantities and sizes, for information that pertains to fabrication methods or construction techniques, and for coordination of work of all Divisions of the work. Deviations, if any, from Contract documents shall be clearly and completely indicated (by a separate letter if deviations are extensive) in the submittals, and the lack of such is deemed complete compliance with Contract Documents without any deviations. Submittals favorably processed will not relieve the Contractor of responsibility for deviations not so reported nor for errors in the submittal.
 - 2. In addition to the above, upon permission to proceed after review of submittal and prior to the installation of work, submit dimensioned and scaled drawings (not less than 1/4-inch equal to one foot) of all mechanical equipment rooms and areas. Such layouts shall indicate, but not be limited to, all mechanical equipment, control panels, piping, housekeeping pads, ductwork, tube pull, access and maintenance clearances, and other like items. The layout shall also indicate major equipment to be provided under other Sections of work.
 - 3. Contractor Stamp: All submittals shall be stamped with the following text and signed by the Contractors representative:

"IT IS HEREBY CERTIFIED THAT THE PRODUCTS SHOWN AND MARKED IN THIS SUBMITTAL ARE IN COMPLIANCE WITH THE CONTRACT DOCUMENTS AND

CAN BE INSTALLED IN THE ALLOCATED SPACES EXCEPT WHERE NOTED AS DEVIATIONS.

CERTIFIED BY:----- DATE:-----

4. All submittals shall be complete and with catalog data and information properly marked to show, among other things, equality of material (where substitution is allowed and desired), adequacy in capacity and performance to meet minimum capacities of performance as specified or indicated. Arrange the submittals in the same sequence as these specifications, and reference (at the upper right-hand corner) the particular specification provision for which each submittal is intended. Incomplete submittals will be rejected.
 5. For all work under Division 23, the notations by the Contractor or Supplier on submittal documents "Per Plans and Specifications", or "As Specified", or similar wording or phrasing is not acceptable and will be cause of rejection. Complete descriptive submittals are required for all Division 23 work.
 6. Refer to the other sections of this Division for specific requirements.
- B. Material List: Within 15 days after award of Contract, submit for approval a complete list of materials proposed for use. Furnish names and addresses of manufacturers, catalog numbers (where applicable) types and trade names. For purposes of uniformity, only one manufacturer will be accepted for each class or type of material. This list is in addition to Shop Drawings.
- C. Shop Drawings: Submit shop drawings with such promptness as to cause no delay in the work. Do not commence fabrication of the equipment until the approved drawings are received from the Owner's representative.
- D. Other Submittals: As required by other sections of this Division.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION METHODS

- A. Workmanship shall be in the best standard practice of the trade.
- B. Execute the work so as to contribute to ease of operation and maintenance, maximum accessibility and best appearance. Execute it so that the installation will conform and adjust itself to the building structure, its equipment and its usage. The work shall be symmetrical, plumb, uniform, properly aligned, and firmly secured in place.
- C. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.2 TESTS

- A. General:
 1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
 2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.
- B. Specific: Refer to the other sections of this Division for test requirements.

3.3 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

- A. Protect materials against dirt, water, chemical and mechanical damage both while in storage and during construction.
- B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.
- C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop fabricated ductwork.
- D. Keep cabinets and other openings closed to prevent entry of foreign matter.

3.4 CLEANUP AND HOUSEKEEPING

- A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.
- B. Leave exposed parts of the mechanical work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

3.5 PROJECT CONDITIONS

- A. Site Examinations and Conditions:
 - 1. Regard information relative to existing conditions, services and structure as approximate only. Verify dimensions and locations, and be knowledgeable of all working conditions before submitting Bid. Verify pressure, location, size, and elevation of existing services (to which points of connection are to be made or crossed) as soon as possible and prior to commencement of any new work.
 - 2. Make minor deviations necessary to conform to actual locations and conditions. Submission of Bid presumes proper examination of Site, locations, dimensions and conditions, and no additional cost will be honored for lack of such examinations.
- B. Existing Services: Examine the Contract Drawings and visit the project site to ascertain the extent of the existing services. Where existing equipment/services serving existing structures and/or existing structures to be demolished are to remain in service, reroute, relocate, or extend such existing equipment and/or services to accommodate this project without additional cost.
- C. Interruption of Existing Services: Where it is necessary to reroute existing services or utilities, or to make connections of new work to existing services or utilities, give timely written notice of such intent to the Owner and secure written approval before proceeding. Make all such interruptions at such time as permitted by the Owner. Anticipate such interruptions to be made outside of normal working hours or normal working days; therefore, no additional cost will be permitted for such work. Except in a case of emergency involving life, limb or health, do not operate any existing equipment (including valves). Where such operations are necessary, they shall be performed by the Owner's personnel.
- D. Access and Placement of Work:
 - 1. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped, disassembled, or disassembly of equipment at Project Site and re-assembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to

accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.

2. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Mechanical Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.
- E. Verification and Coordination: Drawings indicating suggested distribution routes are diagrammatic only, and all scaled and figured dimensions are approximate and are indicated for estimating purposes only. The Drawings do not indicate necessary offsets and like items. Do not construe Contract Drawings as fabrication drawings. Prior to fabrication and installation of work, verify all dimensions, sizes and distribution routes with actual conditions, and prepare submittal and fabrication drawings. Coordinate to avoid possible conflicts and resolve same where such exist. Install work to conform to structure, avoid obstruction, preserve headroom, and keep openings and passageway clear. Changes necessary, resulting from such verification and coordination, shall not be a cause for additional cost.
 - F. See Drawings for extent of demolition.

3.6 WARRANTY

- A. Guarantee, in writing, all work against fault of any product or workmanship for a period of not less than one year after formal acceptance by the Owner; except, where longer periods are specified in the Specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components that are inactive because of said failure shall be suspended. The warranty period for such component shall resume running for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.
- B. Neither payments for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence of omission of Contractor in doing the work.

3.7 SAFETY REQUIREMENTS

- A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts in accordance with the OSHA 1910.219. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or create a fire hazard.

3.8 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, furnish printed copies of these recommendations to the installing Contractor and Resident Engineer prior to installation. Do not proceed with the installation of the item until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

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SECTION 230500

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. The contract documents shall apply in their entirety to the work specified herein.
- B. Submittals: Submit shop drawings and manufacturer's data on each item marked [S] in accordance with the Division 1 section on submittals and Section 230000, General Mechanical Requirements.
- C. Maintenance and Operation Manuals: Provide manufacturer's maintenance and operation manuals on each item marked [M/O] in accordance with the Division 1 section on maintenance and operation manuals and Section 230000, General Mechanical Requirements.

PART 2 - PRODUCTS

2.1 ELECTRICAL MOTORS [S] [M/O]

- A. Provide all motors indicated on drawings necessary for equipment under the Mechanical Work. See electrical drawings for voltage and phase of electrical services.
- B. Unless otherwise specified, all motors 1/2 HP or larger: heavy duty, ball bearing, squirrel cage induction type in drip proof or splash proof enclosure, 1.15 service factor, and shall be suitable for the voltage system specified or indicated. Motor speed shall not exceed 1750 rpm unless otherwise indicated or specified. Motors exposed outdoors: either epoxy encapsulated winding or TEFC enclosure.
- C. Each motor shall have sufficient starting torque to start the apparatus driven.

- D. Provide all motors with junction boxes or terminals boxes and provide adjustable slide rails for all motors with belt drives. All motors shall have a nameplate voltage rating of the specified operating voltage.
- E. Provide overload protection on single phase motors.
- F. Motors rated 1 HP and larger shall have shaft, bearings, and etc. capable of operating with multiple grooved sheaves and two or more belts.
- G. Provide with nameplates permanently attached to exterior housing with manufacturer's name and all electrical characteristics specified thereon.
- H. Motors shall be Lincoln, Westinghouse, General Electric, or approved equivalent.
- I. Brake horsepower shall not exceed 90% of rated motor horsepower.

2.2 MOTOR STARTERS [S] [M/O]

- A. See Electrical Drawings for voltage and phase of electrical services.
- B. Starters for motors will be provided under Division 26. Provide to Division 26 the data necessary for motor starter heater sizing for all motors.
- C. Enclosure: NEMA 1 (unless location of starters dictates otherwise) of sufficient size to contain all accessories specified.

2.3 BELT DRIVES [S] [M/O]

- A. V Type. Drives requiring not more than 2 belts: variable pitch type; size for mid-point of operating range. Drives requiring 3 or more belts: nonadjustable constant speed type. Provide belts in matched sets.
- B. All belt drives shall have a minimum rating of 1.5 times the motor nameplate horsepower rating.

2.4 BELT AND DRIVE GUARDS [S]

- A. Provide all rotating equipment drives and couplings with suitable guards.
- B. Drive guards shall be as standard by the equipment manufacturer.
- C. Belt guards shall be as standard by the equipment manufacturer.

2.5 DIELECTRIC UNIONS [S]

- A. Dielectric unions or flanged unions: constructed so that two pipes being connected are completely insulated (including bolt sleeves and washers) from each other with no metal-to-metal contact; EPCO or approved equivalent.

- B. Unions shall have a water-impervious insulation barrier capable of limiting galvanic current to 1 percent of the short-circuit current in a corresponding bimetallic joint and, when dry, shall also be able to withstand a 600-volt breakdown test.

2.6 PRESSURE AND TEMPERATURE TEST PLUGS [S]

- A. Brass body and gasketed cap, 1/4-inch mpt fitting to receive either a temperature or pressure probe 1/8-inch O.D. with neoprene (max. 200 degrees F) at 500 psi or nordel (max. 275 degrees F) at 500 psi valve core; "Pete's Plug" or approved equivalent.

2.7 PIPING SUPPORTS [S]

- A. See Section 230548, Vibration, and Seismic Controls for HVAC Piping and Equipment regarding structural supports in compliance with seismic requirements; supports shall be as specified therein. Unless otherwise indicated or superseded by cited seismic requirements, pipe hangers and supports as follows:
 - 1. See Section 230548, Vibration, and Seismic Controls for HVAC Piping and Equipment for resilient support of pipes.
- B. Pipe Hangers: Carbon steel hanger with plain (black) or galvanized finish.
 - 1. Piping 5-inches or smaller: Conforms to Manufacturer's Standardization Society (MSS) SP-58, Type 5 hangers; Kin-Line 450 or approved equivalent.
 - 2. Hangers for copper piping shall be furnished with a processed felt lining; Kin-Line 450F or approved equivalent.
- C. Pipe Clamps: Carbon steel with plain (black) or galvanized finish. Provide with copper finish for use on copper piping.
 - 1. For Vertical Piping: Conforms to MSS SP-58, Type 8; Kin-Line 470 or approved equivalent.
 - 2. For Horizontal Piping and Framing Channels: Short clamp (strap) for channel mounting; Kin-Line 477 or approved equivalent.
- D. U-Bolts: Carbon steel U-bolt with plain (black) or galvanized finish and four finished hex nuts; conforms to MSS SP-58 type 24; Kin-Line 438 or approved equivalent.
- E. Pipe Anchor Chair: Unit consisting of a carbon steel, notched, HR channel; U-bolt; and hex nuts; Kin-Line 438, or approved equivalent. (no known equivalent).
- F. Pipe Anchors:
 - 1. Welded Tee Pipe Anchor, for piping 3-inches to 6-inches: Steel, welded, tee-shaped anchor; Pipe Shields Model C1000, or approved equivalent (no known equivalent).
- G. Trapeze Hangers: Trapeze hangers for piping shall be used where indicated or required and shall be fabricated in accordance with SMACNA Seismic Restraint Guide, latest edition.
- H. Support Channels: 1-5/8-inch by 1-5/8-inch, 12 gauge steel channel. Single channel: Superstrut A-1200, or approved equivalent. Double channel: Superstrut A-1202, or approved equivalent.
- I. Hanger Rods: Solid mild steel, sizes as specified below.

Pipe Size

Rod Diameter

1/2-inch through 2-inches	3/8-inch
2-1/2-inches through 3-1/2 inches	1/2-inch
4-inches and 5-inches	5/8-inch

- J. Sound and Electrolysis Isolators: Provide sound and electrolysis isolators at all hangers and supports for un-insulated piping and on other piping where incompatible metals would contact each other. Isolators shall be factory fabricated, hinged, cadmium plated steel shell with processed, non-conducting hair felt isolating pad permanently attached with adhesive; Stoneman "Trisolators", or approved equivalent.
 - 1. Option: Piping isolators for bare un-insulated piping can be integral part of the pipe hanger.
- K. Connection of Hangers to Structure: Factory fabricated steel devices or other equal suitable steel inserts, clamps, and brackets as required, Devices shall comply to MSS-SP-58.

2.8 PIPE INSULATION INSERTS [S]

- A. All insulated piping 2-inches and larger shall be provided with pipe insulation inserts with steel jackets at all pipe hangers and supports.
- B. Pipe Insulation Inserts: Insert shall consist of a galvanized steel jacket, minimum of 26 gauge to 16 gauge thickness depending on pipe size, and a waterproofed calcium silicate insulation insert impregnated with a fire resistive vapor barrier compound; insert thickness shall match the thickness of the specified insulation and shall extend a maximum of 1-inch beyond sheet metal; pipe Shields Model A2000, Kin-Line #463CW or approved equivalent.

2.9 ACCESS DOORS [S]

- A. Flush-mounted sheet metal access doors with lock and concealed hinge; stainless steel door; Milcore, or approved equivalent.
 - 1. Access doors through fire-rated separations shall have like fire rating.

2.10 EQUIPMENT IDENTIFICATION [S]

- A. General: Identify all equipment using brass discs or laminated plastics. Install as specified below in readily visible locations not interfering with insulation or equipment operation.
 - 1. Brass Discs: Provide minimum 0.040-inch in thickness and 2-inches in diameter or square. Top line of each tag shall have 1/4-inch high black filled letters to indicate designation of service. Bottom line shall have 7/16-inch high black filled numbers to indicate equipment or valve number.
 - 2. Laminated Plastic: Provide white on black with engraved black letters. The equipment identifying name and number lettering size shall be a minimum of 1/4-inch in height, nameplate data 3/16-inch in height and the manufacturer's name and location 1/8-inch in height. Provide laminated plastic tags either 2-1/2-inches by 3-1/2-inches or 3-1/2-inches by 5-inches, as required.

2.11 PIPING IDENTIFICATION [S]

- A. Piping identification shall be by semi-rigid plastic markers or vinyl coated cloth; minimum information: base color, flow direction arrow, and fluid being conveyed.
 - 1. Service Markers, Interior Locations: W.H. Brady Co. Type B-500 vinyl coated cloth tape or Type B-350 Perma-Code Thin Film, or approved equivalent.
 - 2. Service Markers, Exterior Locations: W.H. Brady Co. Type B-946G, Brady B-915 Snap-on, or approved equivalent. Apply mechanically affixed with coated wire straps or approved equivalent.
- B. Base color coding and size of letters and arrows shall conform to ANSI A 13.1, "Scheme for the Identification of Piping Systems."

2.12 PRIMERS AND PAINTS [S]

- A. All equipment furnished under Division 23, unless otherwise noted, shall be furnished with a factory applied prime coat.
- B. Where field priming or touch-up priming is required, primer shall be as follows for ferrous metal surfaces:
 - 1. Metal Surfaces, Not Galvanized: Latex, corrosion resistant primer suitable for metal surfaces or Epoxy-polyamide, green primer paint, formula 150, type I (QPL).
 - 2. Metal Surfaces, Galvanized: Galvanized repair compound with high zinc dust content; ZRC Cold Galvanizing Compound, or approved equivalent (no known equivalent).
- C. Finish painting of Mechanical equipment furnished under Division 23: See Division 9 section on painting.
 - 1. Non-metallic surfaces: Latex (Acrylic Emulsion, Exterior Wood and Masonry) Paint.

2.13 SEALANTS [S]

- A. Non-fireproof Penetrations: Silicone rubber sealant; DowCorning 785/4, or approved equivalent.
- B. Fireproof Penetrations: Sealant shall comply with ASTM-E-814 (UL 1479 or UL 94); 3M Brand Fire Barrier Penetration Sealing System with CP-25 caulk, or approved equivalent.

2.14 SEALANTS, WATERSTOP

- A. Cold applied, pre-formed, plasticized, waterstop sealing compound consisting of blends of refined hydrocarbon resins and plasticizing compounds; Synko-Flex Waterstop and Primer, or approved equivalent (no known equivalent).

2.15 BOLTED MECHANICAL SEALS [S]

- A. Seals shall be modular, bolted, mechanical link type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Tightening of the bolts shall cause the rubber sealing elements to expand to form a water-tight seal between the pipe and the sleeve; Thunderline "Link-Seal" Model LS, or approved equivalent.

2.16 PIPE SLEEVES

- A. Sleeves in Concrete Floor Slabs: Schedule 40 black steel pipe.
- B. Sleeves in all Fire Walls (regardless of Construction), Concrete or Masonry Walls: Schedule 40 black steel pipe.
- C. Sleeves in all Walls and Partitions (except Fire Walls, Concrete or Masonry Walls): 18-gauge galvanized steel.

2.17 NON-SHRINK GROUT

- A. Non-shrink, non-metallic, non-corrosive cementitious grout; 5000 psi compressive strength at 28 days; Sika SilkaGrout 212, or approved equivalent.

2.18 VENT STACK FLASHING

- A. Factory-fabricated, caulk type flashing for piping up to 8-inches; Josam 26450, or approved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install products in accordance with product manufacturer's recommendations. After installation of systems and until formal acceptance of systems by the Owner, be responsible for operation and maintenance of systems.

3.2 FORMING, CUTTING, AND PATCHING

- A. Provide Forming, recesses, chases, blocking and grounds necessary for Mechanical Work.
- B. Provide cutting (including core drilling and saw cutting), patching and repairing existing structures to accommodate the Mechanical Work. Such work shall include voids, holes, and the like resulting from removal of existing or addition of new Mechanical Work. Restoration shall match existing work.
- C. Core drill all holes through existing concrete structures. Before drilling through any structural members, obtain written permissions from the Resident Engineer. Before coring, check all proposed hole locations with electronic device to assure clearance of obstruction (i.e., reinforcement bars, piping, conduits, etc.).
- D. Saw cut all existing concrete and masonry openings and slabs.

3.3 ELECTRICAL WORK

- A. Coordinate with Division 26. See Division 26 Contract Documents for voltage and phase of electrical services.

- B. All power wiring and conduits for same serving motors, and where indicated on Division 26 Contract Drawings, to mechanical control panels, separate or equipment mounted, shall be provided under Division 26.
- C. The following shall be provided under Division 23:
 - 1. Pre-wired mechanical control panels.
 - 2. All automatic or temperature control and interlock wiring, regardless of voltage, and conduits for same necessary for proper operation of equipment under Division 23. This includes interlock wiring between motor starter coils, interlocking relays, contactors, mechanical equipment control panels, temperature control devices, and temperature control panels.
 - 3. Power wiring and conduits for same not indicated on the Division 26 Contract Drawings to mechanical control panels (separate or equipment mounted).
- D. Install all wiring under Division 23 in rigid conduit or electrical metallic tubing indoors and in rigid conduit outdoors. All such wiring shall be concealed.

3.4 BELT DRIVES

- A. Select drives for proper speed required for conditions indicated. Conditions indicated are estimated conditions and may vary under actual operating conditions. To adjust speed for actual operating conditions, change drive as often as necessary, at no additional cost.

3.5 DIELECTRIC UNIONS

- A. Install dielectric unions in acceptable locations and provide devices for all piping and equipment connections where ferrous and copper metal is joined.
- B. Where piping is buried, provide additional protection in the following manner. Thoroughly clean device and piping surfaces 5-feet upstream and downstream of connection point. Prime piping surface to be covered. Wrap connection point and piping with double wrapping of identified pressure-sensitive tape.

3.6 FLASHING

- A. Flash and counter flash with metal to make waterproof all penetrations through roofs or exterior walls. Roof flashing shall have a minimum 8-inch skirt. The metal flashing and counterflashing shall be the same material as the equipment to which they are attached. Factory-fabricated flashing may be used for piping. Prior to any interior finish work, test the integrity of all flashing with water hose.

3.7 WELDING

- A. All welding shall comply with provisions of applicable ASME Boiler and Pressure Vessel Code, ANSI Code for Pressure Piping, or other statutes or ordinances having jurisdiction. All welders shall be certified for all welding positions under the qualification tests prescribed by the National Certified Welding Bureau; National Association of Plumbing, Heating, Cooling Contractors; or by other reputable testing laboratories, using procedures covered in the ASME Boiler Construction Code, Section IX, Qualification standards for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators; and shall hold a current

certification of his qualifications obtained within 12 months prior to date of contract. Prior to welding operation, submit for review evidence of such certification.

3.8 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be in accordance with the requirements of the Division 2 section on the excavation and backfilling, as specified in other Division 23 sections, and as herein described. Where depths or invert elevations are not indicated, provide minimum coverage (above top of pipes) as follows:
 - 1. Any piping under slab (top of pipe to underside of slab): 18-inches.
 - 2. Steel, cast iron, and copper in other locations: 18-inches.
- B. Excavate to undisturbed earth; cut level and form true. Remove debris, rubbish and soft material (such as mud). Where rock is encountered, undercut trenches 6-inches and fill with well tamped neutral sand and pea gravel to proper elevation. During installation of piping, maintain excavation free of standing water. Undercut trench 6-inches and install piping in a 6-inch neutral sand envelope.
- C. Do not backfill until piping has been successfully tested.
- D. Backfill to a point 12-inches above top of piping with earth (excavated material may be used) free of clay, debris, rubbish, rocks, or clods over 4-inches in the greatest dimensions. Backfill above 12-inches from top of piping may be with excavated material. Apply backfill by hand in 6-inch deep layers the full width of the trench. Moisten each layer (do not flood or puddle), and hand tamp to a minimum 90 percent compaction before proceeding with the next layer of backfill.
- E. Do not excavate under foundations or footings except in manner permitted. Do not backfill until installed piping has been successfully tested.
- F. Provide a 12-inch neutral sand envelope all around buried tanks.
- G. Dewatering:
 - 1. Lay pipe in dry trenches and keep trenches completely dry until piping system has been tested, cleaned, insulated, sealed, inspected and accepted by the Owner and completely backfilled before dewatering function ceases.
 - 2. Furnish and operate pumps, well points, siphons or other equipment as may be required to provide complete dewatering of trenches and disposal of excess water.

3.9 PIPE SUPPORT INSTALLATION

- A. Support all piping, horizontal and vertical, with clamps or brackets. Independently support all line-mounted equipment. Provide at least one hanger for each branch piping and at each change of direction. Secure all hanger rods with double nuts and lock washers. Do not use perforated (plumber's) tape. Support vertical multiple-story piping at each floor with pipe clamps.
- B. Maximum Hanger Spacing:
 - 1. Cast Iron Soil, Waste, or vent Piping: Hangers at 5-feet and at each joint or fitting.
 - 2. Steel Piping: 1-inch and smaller, hangers at 8-feet; 1-1/4-inches and larger, hangers at 10-feet.
 - 3. Copper Piping: 1-1/2-inches and smaller, hangers at 6-feet; 2-inches and larger, hangers at 10-feet.

4. In all cases, space pipe supports to provide adequate support for the pipes, the medium in the pipes, insulation, valves, and fittings to prevent any sagging or separation of joints.

3.10 PIPING INSTALLATION

A. Layout of work:

1. Perform all dimensional layout of the Work and establish all lines and grades as set forth on the Drawings.
2. Be responsible for conformity of the finished work with drawings and specifications.

B. Installation:

1. Inspect all piping prior to installation. Pipe found unsatisfactory on inspection or damaged by handling shall be promptly removed from the job site.
2. All piping systems shall be graded and valved to provide complete drainage, venting, and control of all systems.
3. Install all buried non-metallic piping with a continuous number 14 plastic-coated copper wire paralleling piping.
4. Use reducing fittings for pipe size changes; do not use brushings. Make all changes in pipe material with pipe adapters.
5. Prior to installation of piping to or at mechanical equipment, verify with the equipment manufacturers as to the clearance required for maintenance, repair, inspection, and part replacement for the respective equipment. Install piping to provide such clearance so that an absolute minimum of piping is required to be disturbed. Provide means for removal of such piping. Provide unions, flanges, and mechanical couplings at connections to equipment.
6. Where equipment connection sizes are smaller than piping sizes indicated, make size reduction immediately adjacent to the equipment connections. Flanges or unions at such equipment connection points may be the same size as the equipment connections.
7. Install horizontal sanitary piping to uniform grades conforming to the applicable Code for this installation.
8. Conceal all piping in finished portions of the building unless noted otherwise on the Drawings.
9. Coupled short sections of pipe, bushings, close nipples, long screws, bullhead tees and crosses are prohibited. Bullhead tees and crosses are permitted only in fire sprinkler systems.
10. Install all piping in such a manner as to prevent any undue noise from the flow of water under normal conditions.
11. Branch tees in piping, provided that the branch size is two pipe sizes or smaller than the main size, may be made with factory-manufactured outlet fittings with funneled inlet and with socket or threaded outlet as required. The fittings schedule shall be the same as the piping to which they are connected. For copper tubing fittings shall be joined to main by silver brazing. The use of extruded tees for branch takeoffs that are fabricated from the piping material being installed is expressly prohibited and will be rejected.
12. Install piping to permit free expansion and contraction, except where the Drawings specifically indicate an anchor or guide. Do not connect stiffening structural members to bends or elbows.
13. Use offsets necessary to prevent undue strain on piping. The springing of piping into place is prohibited.
14. Select and install pipe supports and hangers in such a manner as to impose only negligible restraint on the free movement of piping and not deform piping. No anchors shall be employed, except as indicated on Drawings.
15. Locate pipe supports as close as possible to valves or other heavy piping specialties.

16. Carefully locate supports and hangers so they do not hinder free movement of adjoining piping or occupy open space in a pipe rack.
17. Mark all stub-outs below grade with monuments identifying the services.
18. Provide shut-off valves at each division of main piping and at each branch serving one room or a group of adjoining rooms to enable isolation of fluid carrying piping systems for each portion of the building (buried piping excepted).
19. Valves shall be full size of the line in which they are installed (automatic control valves excepted). Prior to installation of control valves, verify with control manufacturer as to sizes, piping hookup, and the like for same.
20. Install valves with stems straight up wherever possible; do not install valves with stems below the horizontal position.
21. Provide spool between two adjacent valves.
22. Properly grade all water piping to provide flow, air elimination, and drainage. Do not install piping so as to create noise or flow impairment.
23. Separately pipe, with shut-off valve, equipment drains to nearest floor drain, or as noted on Contract Drawings.
24. Do not permit the use of any mechanical piping system under this Division of Work to be used as electrical grounding.
25. Buried Piping:
 - a. Carefully handle and lower pipe in such a manner as to avoid damage to the pipe.
 - b. Excavate a socket hole under the joint so that pipe will be supported on its body. Provide socket holes large enough (but not excessive) to allow adequate space for workmen to "make" the joints.
26. Thrust Blocks:
 - a. Provide concrete thrust blocks at all changes in direction of buried piping of non-restrained mechanical joined pressure systems and other systems as required.
 - b. Provide thrust blocks for buried restrained mechanical jointed piping systems where indicated.
 - c. Provide thrust blocks of 3000 psi concrete mix conforming to the requirements of the Division 3 section on concrete.
 - d. Provide thrust blocks of the required size and shape necessary for the specific system pressure and soil bearing capacity at the particular locations.
 - e. Exercise care to avoid encasing fittings, bends, valves, etc., in concrete to the extent that it will hamper maintenance.

3.11 PIPE JOINTS

- A. Threaded Steel or Brass Pipe:
 1. Cut square and remove all burrs. Ream for full flow.
 2. Cut threads with clean dies. Apply thread compound to male threads only. Refer to specific piping system for type of thread compound.
 3. After joining, not more than three full threads shall remain exposed. Coat exposed threads of steel pipe with appropriate type red paint.
 4. Make-up brass, chrome plated pipe, or stainless steel pipe with strap wrenches.
- B. Copper Tubing:
 1. Cut square and remove all burrs. Ream for full flow.
 2. Clean outside ends of tubing and male fittings and sockets of female fittings to bright finish. Clean with emery cloth.
 3. Properly apply flux to surfaces being jointed. Application and type of flux shall be as recommended by the specific brazing or solder manufacturer.
 4. Remove stems, washers and internal parts of valves prior to brazing or soldering.
 5. Refer to specific piping system for type of brazing metal and solder.

- C. Ductile Iron Pipe and Fitting Mechanical Joints: Install mechanical joints in accordance with AWWA C 600.
- D. Grooved Pipe and Fitting Mechanical Joints: Install joints including grooving of pipe, in accordance with the coupling and fittings manufacturer's recommendations and printed instructions. Before couplings are assembled, pipe ends and gasket exterior surfaces shall be lightly coated with a lubricant manufactured especially for this application and recommended by the coupling and fitting manufacturer.
- E. Flanged Joints: Use flanged joints for making piping connections to flanged valves, fixtures, and equipment, and to other flanged piping components. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed (equally torqued).
- F. Cast Iron Soil Pipe:
 - 1. Hub-and-Spigot Compression Joints: Install rubber or neoprene gasket compression joints in accordance with the recommendations and printed instructions of the pipe and fitting manufacturer. Joints shall be installed with hub ends pointing upgrade. Pipe with cracked hubs shall be replaced.
 - 2. Hubless Joints: Install clamp assemblies with bolts alternately and incrementally tightened to manufacturer's recommended torque. Use a single set-point torque wrench manufactured specifically for this purpose. The use of screwdrivers or other types of wrenches will not be permitted. After a period of at least 24 hours, re-torque each bolt.
- G. Solvent-Weld Joints in Plastic Piping: Install solvent welded joints for CPVC, PVC or ABS plastic piping in accordance with the recommendations and printed instructions of each respective pipe and fitting manufacturers and with requirements of pertinent ASTM standards.

3.12 WELDING

- A. Welded joints, fabrication, assembly and erection shall conform to the requirements of ANSI B 31.1 "Power Piping" of the American National Standard Code for Pressure Piping. Perform all welding by the metal-arc welding process, either manual, semi-automatic or automatic.
- B. Welding qualifications shall conform to the requirements of Section IX "Welding and Brazing Qualifications" of the ASME Boiler and Pressure Vessel Code. Proof of qualifications, issued within the previous twelve months, is required from a testing agency approved by the Owner.

3.13 PIPE SLEEVES AND PLATES

- A. Sleeves:
 - 1. Provide sleeves for all pipes passing through walls, partitions of floor slabs unless specified otherwise.
 - 2. Sleeves in concrete floor slabs: Sleeves shall project 2-inches above finished floors, unless specified otherwise.
 - 3. Sleeves in all Fire Walls (regardless of construction), Concrete or Masonry Walls: Finished flush with wall finish, unless specified otherwise.
 - 4. Sleeves in all Walls and Partitions (except Fire Walls, Concrete or Masonry Walls): Finished flush with wall or partition finish.
 - 5. Provide 1/2-inch clearance completely around pipe between sleeve and non-insulated piping, except where pipes pass through exterior walls below grade, provide full 1-inch clearance between pipe and sleeve.

6. Sleeves for insulated piping shall be sized for insulation, pipe and clearance specified for non-insulated pipes.
 7. Caulk sleeves set in fire rated construction with sealant specified for fireproof penetrations and caulk sleeves set in non-fireproof construction with sealant specified for non-fireproof penetrations.
 8. Seal sleeves watertight when they are installed in outside walls, walls below grade and in floor slabs with waterproof epoxy grout, except as specified otherwise.
- B. Plates: Provide chrome-plated hinged escutcheon plates with locking devices where pipes pierce finished surfaces. Plates shall fit outside of pipe insulation.

3.14 EQUIPMENT INSTALLATION

- A. Install equipment where shown, as indicated, and in accordance with the manufacturer's recommendations for the specific service.
- B. Provide anchor bolts, setting Drawings and templates for setting equipment.
- C. Assure correct alignment of equipment after setting.
- D. Where grouting is necessary, use non-shrink type.
- E. Before bolting any equipment coat threads with an anti-seize and lubricating compound. Do not use powder driven anchors unless written permission has been obtained from the Resident Engineer.
- F. Provide all exposed moving or rotating parts of machines with guards in compliance with OSHA requirements. Install all guards in removable sections, if necessary, and with studs and wing nuts for removal of same in maintenance. Make provision for RPM readings on guards covering end of shafts; enclose fan belts at both sides of belts.

3.15 MAINTENANCE AND ACCESS TO EQUIPMENT

- A. Where valves, dampers, control devices, coils, or other like devices (i.e, plumbing P-trap, water hammer arresters, gauges, thermometers) requiring maintenance, checking or readings are inaccessibly concealed in walls or ceilings, and where indicated, provide square or rectangular access doors. Where space permits, doors for ceiling installation shall not be less than 18-inches by 18-inches. Prior to installation, verify all access locations.
- B. Where there are lubrications within equipment, extend such to exterior of equipment.

3.16 REVIEW OF WORK

- A. Do not allow or cause any mechanical work to be covered, concealed or enclosed until such work has been tested and reviewed. Should such work be covered, concealed or enclosed before being tested and reviewed, such shall be uncovered and thereafter restored at no additional cost.

3.17 EQUIPMENT IDENTIFICATION

- A. **Manufacturer's Nameplates:** Provide all equipment with manufacturer's nameplates secured to the respective equipment and indicating, but not being limited to, the manufacturer's name, model, size, serial number, capacity and electrical characteristics. Clean, polish and protect all such nameplates with a coat of clear protective finish.
- B. **Equipment Tags:** Identify all equipment (such as machinery, motor starters, control panels, pushbuttons and other like devices) exposed to view with identification tags. Secure tags to equipment surface. Where size or surface curvature does not permit such, secure with No. 16 brass jack chain.
- C. **Valve Tags:**
 - 1. Identify each valve with a tag with distinguishing number. Secure tags to valves with No. 16 brass jack chain.
 - 2. Provide valve chart and schedule in aluminum frame with clear heavy plastic shield, and mount same at location directed. Indicate on the Record Drawings the location of valves with numbers corresponding to the valve schedule. Valve chart and schedule shall include, but not be limited to, tag number, location, usage/function, valve manufacturer's name and valve model number. Numbers for new valves shall continue from existing valve numbering system.
- D. **Piping Identification:**
 - 1. Identify each pipe, whether concealed or exposed, as to the content and character of material it carries (piping buried excepted).
 - 2. **Location of Markers:** Not to exceed 20-feet on straight run of pipe (including risers and drops) and so located as to be conspicuously visible from any reasonable vantage point; adjacent each valve; adjacent each tee; at each side of penetration of the structure or enclosure; at each obstruction.

3.18 PRIMING, PAINTING, AND COATING

- A. Properly clean surfaces to be touched up of rust, dirt, scale, wax and other deleterious materials. Prime surfaces. Touch up with like material all damaged galvanized or factory-primed metal surfaces. Do not prime over manufacturer's nameplates on equipment.
- B. Coat all bare steel parts of piping accessories below grade with coats of coal-tar based bituminous mastic.
- C. Except for factory priming, factory finish painting and otherwise specified under this Article, all field priming (except touch up) and finish painting shall be under other Divisions.
- D. Paint flat black interior surfaces of all concealed unlined galvanized sheet metal ductwork behind air outlets and inlets.
- E. All exposed insulation surfaces in finished areas shall be ready for finish painting; glue size if necessary.

3.19 CLEANING AND DE-GREASING OF PIPING

- A. **General:**
 - 1. Clean all piping systems to remove all dirt, grease, scale, foreign substances, etc., as specified in each separate section of the Specifications.

2. Prior to commencing work, submit for approval a complete procedure for cleaning and flushing for each separate piping system. Include flushing source, system inlet flushing pressure and size of inlet and outlet flushing connections with their locations for each system. Install flushing connections at all low points of each piping system to ensure complete flushing of the system.
3. Use air and/or gas blown through the lines of gas and air systems, unless specified otherwise, to prove the piping clean. All other piping systems shall be thoroughly flushed out with water unless specified otherwise.

3.20 TESTING OF PIPING

- A. Provide notification of test at least three working days prior to tests on all part of any piping system. Do not allow or cause any piping system to be insulated, covered, concealed or enclosed until such systems have been tested and reviewed.
- B. Provide all necessary materials (including temporary isolation valves or caps), pumps, testing media and labor for testing. Temporarily remove any device in piping system which will not withstand test pressure specified, and reinstall same after successful testing. Test time begins to accrue full test pressure is achieved.
- C. Testing and inspection of all piping systems and associated equipment for leaks shall be accomplished after installation and cleaning and prior to placing into service. Flanges, threaded joints and all welds shall be left unpainted and un-insulated until the piping systems have been approved.
- D. A rigid visual inspection of each specific piping system shall be made prior to conducting tightness tests, to ascertain that all appurtenances and equipment are provided, properly connected and supported, and in all respects ready for testing.
- E. Equipment such as safety valves and similar equipment shall not be subjected to the piping system test pressure. Equipment shall either be disconnected from the piping or be isolated by valves or blanks during testing and reinstalled after acceptance by the Owner.
- F. Indicating pressure gauges mounted locally may be tested with the lines provided the test pressure does not exceed the scale range.
- G. Orifice plates, rotometers, displacement meters and other line inserts shall either not be installed until completion of all testing, or shall be removed prior to any tests and reinstalled after test has been accepted by the Owner.
- H. The application of pressure to a system shall be under control at all times, so that in no case shall the test pressure be exceeded by more than 6 percent.
- I. Gauges used for testing shall be tested for accuracy as directed or approved by the Owner, and then installed as close as possible to the low point of the piping system.
- J. Do not apply test pressure until the piping system and its contents approach the same temperature.
- K. While piping is under test, exercise care so that excessive pressure does not occur due to increase in ambient temperature.
- L. Piping test pressure shall be as noted in tabulation. If test pressures are not specified, they shall be 150 percent of design pressure for the specific system being tested.

- M. Conduct hydrostatic tests with water at a temperature below 100 degrees F.
 - 1. Fill the system slowly with water and vent at highest points to expel the air before pressurizing.
 - 2. Carefully examine all joints for leaks or defects.
 - 3. Provide connections as required to accomplish the above.

- N. Keep accurate test records of each line or system tested and provide copies of same to Owner after acceptance. Each test shall include:
 - 1. Identification of piping system and test number.
 - 2. Testing medium.
 - 3. Test pressure.
 - 4. Date of test acceptance.

3.21 TESTS AND ADJUSTMENTS

- A. At the completion of the Work, completely adjust all valves and equipment for their proper use and rating.

****END OF SECTION ****

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SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Fastener systems.
 - 3. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 FASTENER SYSTEMS

- #### **A. Powder-Actuated Fasteners:** Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- #### **B. Mechanical-Expansion Anchors:** Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.3 EQUIPMENT SUPPORTS

- #### **A. Description:** Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

PART 3 – EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- #### **A. Metal Pipe-Hanger Installation:** Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

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SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Spring hangers.
 - 7. Restraining braces and cables.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.
- E. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 – PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. California Dynamics Corporation.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Mountings & Controls, Inc.

- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.

- C. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control.
 - 4. Mason Industries.
 - 5. TOLCO Incorporated; a brand of NIBCO INC.
 - 6. Unistrut; Tyco International, Ltd.

- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

- D Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- E Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 – EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 - 3. Brace a change of direction longer than 12 feet (3.7 m).
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Resident Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Resident Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Resident Engineer.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4.1 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

**** END OF SECTION ****

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SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Refrigerant Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 2. ASME A13.1 Colors and Designs: For hazardous material exhaust.

**** END OF SECTION ****

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SECTION 232300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 200 psig (1379 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 325 psig (2241 kPa).
 - 3. Hot-Gas and Liquid Lines: 325 psig (2241 kPa).

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.

2.2 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig (3450 kPa).

2.3 REFRIGERANTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- B. R-410a.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A) or L (B), drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- B. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section 08110 "Steel Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 PIPE JOINT CONSTRUCTION

- A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).

3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust set-point temperature of air-conditioning controllers to the system design temperature.
- B. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Verify that compressor oil level is correct.
 2. Open compressor suction and discharge valves.
 3. Open refrigerant valves except bypass valves that are used for other purposes.
 4. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- C. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**** END OF SECTION ****

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.
5. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.
 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 5. Design Calculations: Calculations for selecting hangers and supports.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

1.4 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 1. Manufacturers: Subject to compliance with requirements, provide by one the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches (76 mm).
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.5 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Mason Industries.
 - 5. TOLCO; a brand of NIBCO INC.
 - 6. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design

considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Supply-Air Ducts: Seal Class A.
 - 3. Exhaust Ducts: Seal Class C.
 - 4. Return-Air Ducts: Seal Class B.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes.
 - 1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 - 2. Brace a change of direction longer than 12 feet (3.7 m).
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Resident Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.

- C. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.

- D. Elbow Configuration:
 - 1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 2) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.

- E. Branch Configuration:
 - 1. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

**** END OF SECTION ****

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SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Backdraft and pressure relief dampers.
 2. Manual volume dampers.
 3. Flexible connectors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60 (Z180).

2. Exposed-Surface Finish: Mill phosphatized.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Duro Dyne Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Pottorff; a division of PCI Industries, Inc.
 5. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm (10 m/s).
- D. Maximum System Pressure: 1-inch wg (0.25 kPa).
- E. Frame: 0.052-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners.
- F. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Felt, Vinyl foam.
- I. Blade Axles:
 1. Material: Galvanized steel.
 2. Diameter: 0.20 inch (5 mm).
- J. Return Spring: Adjustable tension.
- K. Bearings: Steel ball.
- L. Accessories:
 1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.
 3. Electric actuators.
 4. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
 - b. Sleeve Length: 6 inches (152 mm) minimum.
 5. Screen Mounting: Rear mounted.
 6. Screen Material: Galvanized steel.
 7. Screen Type: Bird.
 8. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. METALAIRE, Inc.
 - b. Nailor Industries Inc.
 - c. Pottorff; a division of PCI Industries, Inc.
 - d. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. METALAIRE, Inc.
 - b. Nailor Industries Inc.
 - c. Pottorff; a division of PCI Industries, Inc.
 - d. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.

- e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
 - 1. Size: 1-inch (25-mm) diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
 - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.4 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.5 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.

- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip [3-1/2 inches (89 mm)] [5-3/4 inches (146 mm)] wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.6 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install flexible connectors to connect ducts to equipment.
- G. Install duct test holes where required for testing and balancing purposes.
- H. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Inspect turning vanes for proper and secure installation.

**** END OF SECTION ****

SECTION 233423

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. In-line centrifugal fans.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Greenheck Fan Corporation.
 - 2. Loren Cook Company.
 - 3. PennBarry.
 - 4. Twin City Fan Company.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 3. Companion Flanges: For inlet and outlet duct connections.

4. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

F. Capacities and Characteristics:

1. Vibration Isolators:
 - a. Type: Elastomeric hangers.
 - b. Static Deflection: 1 inch (25 mm).

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

**** END OF SECTION ****

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed face grilles.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

A. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Krueger.
 - b. Nailor Industries Inc.
 - c. Price Industries.
 - d. Titus.
 - e. Tuttle & Bailey.
2. Material: Steel.
3. Finish: Baked enamel, color selected by Resident Engineer.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch (13-by-13-by-13-mm) grid core.
5. Core Construction: Integral.
6. Frame: 1 inch (25 mm) wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade.

2.2 SOURCE QUALITY CONTROL

- ###### A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Resident Engineer for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**** END OF SECTION ****

SECTION 238126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.
- C. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: One year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 3. Trane; a business of American Standard companies.
 4. YORK; a Johnson Controls company.

2.2 INDOOR UNITS 5 TONS (18 kW) OR LESS

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - f. Mount unit-mounted disconnect switches on exterior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage, microprocessor based with subbase to control compressor and evaporator fan with the following features:
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- C. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base that is 4 inches (100 mm) larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- E. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- F. Install seismic restraints.

3.2 CONNECTIONS

- A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

**** END OF SECTION ****

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 2000 V and less.
 - 2. Connectors, splices, and terminations rated 2000 V and less.
- B. Related Requirements:

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire Company.
 - 2. Belden Inc.
 - 3. General Cable Technologies Corporation.
 - 4. Southwire Company.
 - 5. Or Equal
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with NEMA WC 70/ICEA S-95-658.
 - 1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M Electrical Products.
 2. Hubbell Power Systems, Inc.
 3. Ideal Industries, Inc.
 4. ILSCO.
 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 6. Or Equal.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- C. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
- C. Limit quantity of splices to reconnect existing loads only. All other wiring shall be continuous.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance.
 - c. Inspect compression applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.

3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

*****END OF SECTION****

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SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. Harger Lightning & Grounding.
 - 4. ILSCO.
 - 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 6. Thomas & Betts Corporation; A Member of the ABB Group.
 - 7. Or Approved Equal.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
- C. Poles Supporting Outdoor Lighting Fixtures or structures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance.

*****END OF SECTION*****

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Hangers.
 - b. Steel slotted support systems.
 - c. Clamps.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
 - 1. Trapeze hangers. Include product data for components.
 - 2. Steel slotted-channel systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of trapeze hangers.
 - 2. Include design calculations for seismic restraints.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design hanger and support systems, as defined in Section 01300"Contractor Submittals,".
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic."

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. PowerStrut; a part of Atkore International.
 - b. ERICO International Corporation.
 - c. Cooper B-Line.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - e. Unistrut; Part of Atkore International.
 - f. Or Approved Equal.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) Hilti, Inc.
- 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
- 3) MKT Fastening, LLC.
- 4) Or Equal.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) B-line, an Eaton business.
- 2) Empire Tool and Manufacturing Co., Inc.
- 3) Hilti, Inc.
- 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
- 5) Or Approved Equal.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: Stainless-steel springhead type.

7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To New Concrete: Bolt to concrete inserts.
 - 2. To Existing Concrete: Expansion anchor fasteners.
 - 3. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

*****END OF SECTION*****

SECTION 260530

PROCESS INSTRUMENTATION AND CONTROL SYSTEM (PICS) - GENERAL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes materials, testing, and installation of process instrumentation and control system as specified herein and indicated on the drawings.
- B. These specifications shall not be interpreted as permission or direction to violate any governing code or ordinance. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:
 - 1. Instrumentation: Instrument Society of America (ISA).
 - 2. Wiring: California Electrical Code (CEC), ISA S5.3 and S5.4.
 - 3. Control Panels and Equipment: NEMA, UL, and ANSI.
 - 4. Control Logic: NFPA 79.
 - 5. Piping: ANSI B31.3 (instrumentation piping).

1.2 SCOPE OF WORK

- A. The work involves furnishing all hardware, installation, labor, material, equipment, and engineering in strict compliance with the contract documents for the Owner.
- B. Specific items include, but not limited to, the following:
 - 1. Field instruments.
 - 2. Control Panel.
- C. Submittal drawings shall show interface between PLC and field instruments.

1.3 SUBMITTALS

- A. Detailed System Drawings and Data: The submittal shall consist of six sets of detailed drawings and data prepared and organized by the Contractor. All drawings, schematics, layouts, and diagrams shall be done on 11" x 17" sheets utilizing AutoCAD. Two sets of submittals will be returned to the Contractor.
 - 1. Submittals shall be in three-ring hard-cover binders and arranged for convenient use including tab sheets, all indexed, and cross referenced with a separate index for each item.
 - 2. Provide manufacturers cut sheets and manuals for all hardware to be provided.

3. Provide ISA type instrumentation data sheets for each component, together with a technical product brochure or bulletin. The data sheets, as a minimum, shall show:
 - a. Instrument tag designation.
 - b. Component name.
 - c. Manufacturer's model number.
 - d. Calibrated range.
 - e. Instrument location.
 - f. Input and output characteristics.
 - g. Scale range and units (if any) and multiplier (if any).
 - h. Requirements for electric supply.
 - i. Vendor/ distributor
4. Group the data sheets together in the submittal by type. Provide individual data sheets for each instrument with one brochure or bulletin to cover all identical uses of that component.
5. The detailed construction drawing submittal shall include, as a minimum, the following types of drawings and diagrams required for the construction of this project:
 - a. Legend, Symbols, and Index.
 - b. Power Distribution Diagrams.
 - c. Instrument Control Panel Layouts/Construction Drawings/Details.
 - d. Internal Panel Wiring Diagrams.
 - e. Digital I/O Module Wiring Diagrams.
 - f. Analog I/O Module Wiring Diagrams.
 - g. Detailed Loop Interconnection Wiring Diagrams (per ISA S5.3 and S5.4) for the entire system showing all control equipment, instrumentation, electrical equipment, components, wiring, routing, J-boxes, terminations, wire tags, and wire colors. The diagrams shall show the detailed interconnection of all electrical equipment, instrumentation, panels, enclosures, components and the like provided under this contract.

- h. Detailed Ladder Diagrams in a format similar to NFPA 79 (for discrete wiring) to meet the following minimum requirements:
 - 1) Where the internal wiring diagrams of subassemblies are furnished on separate sheets, they shall be shown as a rectangle in the schematic diagram with all external points identified and cross-referenced to the separate sheets of the control circuit. Coils and contacts internal to the subassemblies shall be shown in the rectangle connected to their terminal points.
- i. A cross-referencing system shall be used in conjunction with each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, the purpose of the contact shall be described on the same sheet. Spare contacts shall be shown.
- j. Limit, pressure, float, flow, temperature sensitive, and similar switch symbols shall be shown on the schematic (ladder) diagram with all utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position. If the equipment is shown in a specific position, the position shall be identified.
- k. Contacts of multiple contact devices, e.g., selector switches, shall be shown on the line of the schematic diagram where they are connected in a circuit. A mechanical connection between the multiple contacts shall be indicated by a dotted line or arrow. This does not apply to control relays, starters, or contactors. Additional charts or diagrams may be used to indicate the position of multiple contact devices such as drum, cam, and selector switches.
- l. The purpose or function of all switches shall be shown adjacent to the symbols. The purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram shall be shown adjacent to their respective symbols. The number of positions of the solenoid valve shall be shown adjacent to the valve solenoid symbol.
- m. Arrangement and construction drawings for consoles, control panels, and for other special panels for field installation. These drawings shall include dimensions, location of all components, identification of all components, bill of materials, detailed schematics of all internal wiring, preparation and finish data, nameplates, and the like. These drawings also shall include enough other details to define the style and overall appearance of the assembly; include a finish sample for all panel surfaces.
- n. Installation, mounting, and anchoring details for all field instruments and panel mounted components.
- o. An instrument list including all instruments provided under this project
- p. An I/O List for each PLC in the project.

- B. Complete detailed bills of material: Detailed bill of material for all components shall be provided including complete manufacturers name and model number, quantity to be provided, and cross references to data sheet sections.
- C. Operation, Maintenance, and Repair Manuals:
 - 1. The Operation and Maintenance (O&M) manuals shall be submitted and approved prior to the testing of the project systems. The O&M manuals shall be used to assist with commissioning and any red-lines made during testing shall be revised and resubmitted as the final set of six (6) O&M manuals.
 - 2. The organization of the initial submittal required above shall be compatible to eventual inclusion as one volume of the operation, maintenance, and repair manuals.
 - 3. Operation manuals shall be prepared and submitted to the Owner's Representative for preliminary review in six copies. When the Owner's Representative is satisfied that these are complete and properly prepared, six final sets shall be delivered to the Owner's Representative.
 - 4. The complete operation manual shall contain all the information included in the preliminary equipment submittal, the detailed installation submittal, and the additional information required herein, all bound in hard-cover binders and arranged for convenient use including tab sheets, all indexed and cross referenced with a separate index for each item, and all final as-built drawings with the AutoCAD electronic files.
 - 5. The operation manuals shall contain: (1) calibration and maintenance instructions, (2) trouble-shooting instructions, and (3) instructions for ordering replacement parts.

1.4 QUALIFICATIONS AND RESPONSIBILITY OF CONTRACTOR

- A. The Contractor shall furnish and install all proposed hardware as shown on the drawings and as specified herein. The PLC system installation and wiring connections to peripheral equipment and instruments shall be the responsibility of the system supplier using qualified personnel possessing the necessary equipment and having experience in making similar installations. Evidence of such qualification, as well as notification of the system supplier assuming unit responsibility, shall be furnished to the Owner in writing prior to commencement of the work. The qualification evidence shall include the following:
 - 1. The system supplier shall have experience with the installation of industrial control systems similar in type to those to be installed in this project.
 - 2. A list of completed similar installations including name and address of owner, name of project, and date of completion.
 - 3. The name and qualifications of supervisory personnel to be directly responsible for the installation of the control system.
- B. Under this section, the Contractor shall furnish the following:
 - 1. Special tools and test equipment required by the supplier.

2. Control Panel
 2. Installation, integration and testing.
 3. Documentation.
 4. Warranty (one year).
 5. Shipping and receiving.
- C. All calibration and final checkout of the process instrumentation and control system shall be witnessed by the Owner's Representative to determine if the system complies with the contract documents.
- D. The Contractor shall be responsible for coordinating and interfacing with equipment supplied under these contract documents which are an integral part of the system. Interfacing shall be incorporated in the detailed systems drawings and data section of the contract documents.
- C. The system supplier shall be experienced in the design, programming, and service of this type of equipment. In the event of a dispute as to the acceptability of the system supplier, the Owner's Representative shall make the final determination.

1.5 GUARANTEE

- A. The Contractor shall repair or replace defective components, rectify malfunctions, correct faulty workmanship, all at no additional cost to the Owner during the guarantee.
- B. To fulfill this obligation, he shall utilize technical service personnel designated by the Contractor who was originally assigned project responsibility. Services shall be performed within five calendar days after notification by the Owner's Representative.

PART 2 - MATERIALS

2.1 DESIGNATIONS OF COMPONENTS

- A. In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in Instrument Society of America Standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

2.2 INSTRUMENT TAGGING

- A. Attach a stainless-steel tag to the instrument at the factory. Permanently mark the stainless-steel tag with the instrument tag number. The manufacturer's standard metal nameplate as a minimum shall denote model number, serial number, operating electrical voltage and amperage (when applicable), and date of manufacture.

2.3 INSTRUMENT SYSTEM POWER

- A. Power provided for the instrument system at the facility shall be 120-volt a-c, single phase, 60 Hz.
- B. Where d-c power supplies are not furnished integral with any one instrument system loop, then provide separate solid-state power supplies.

2.4 MATCHING STYLE, APPEARANCE, AND TYPE

- A. All display instruments of each type shall represent the same outward appearance, having the same physical size and shape and the same size and style of numbers and pointers.

PART 3 - EXECUTION

3.1 UNIFORMITY OF COMPONENTS

- A. Components which perform the same or similar functions shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and the same appearance.

3.2 PLC PROGRAMMING

- A. PLC code writer shall provide and coordinate a minimum one (1) workshop with client to demonstrate the project application functionality.
- B. PLC Program shall be standard IEC 61131-3 in Unity Pro XL. The Custom PLC control application shall be written in Derived Function Block (DFB). The City will provide a current PLC control application as reference.
- C. PLC project or control application should be segmented in to multiple program sections. Each section should be proportional and consistent with each process.
- D. PLC Programming, testing, commissioning, trouble-shooting and start-up shall be the responsibility of the Contractor.
- E. Coordinate with the City of San Diego for Sequence of Operations of pumps. Required modes of operation are based on process and user input but not limited to the following - Pressure control, Flow control, Level Control, TOU Control, Manual Override control, etc.

3.3 OPERATOR INTERFACE TERMINAL (OIT)

- A. OIT programming and configuration shall be the responsibility of the Contractor.
- B. OIT shall be interfaced to the PLC control network via Ethernet.

3.3 MOUNTING OF EQUIPMENT AND ACCESSORIES

- A. Mount equipment in accordance with the installation detail drawings as prepared by the Contractor and reviewed by the Engineer. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Do not install consoles, cabinets, and panels until heavy construction work adjacent to computer and telemetry equipment has been completed to the extent that there shall be no damage to the equipment.
- B. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.
- C. Mount local equipment in cabinets or existing panels as specified. Mount associated I/O terminals on a common panel or rack; mounting panels and rack shall be baked enamel.
- D. Coordinate the installation of the electrical service to components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation supervised by the Contractor.

3.4 CALIBRATION

- A. Each instrument requiring factory calibration shall be furnished with calibration data. The calibration data shall be factory certified.
- B. Calibrate systems after installation in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. Accomplish this calibration work by a technical field representative of the single instrument supplier. He shall certify in writing to the Engineer that all calibrations have been made and that all systems are ready to operate.

*****END OF SECTION*****

SECTION 260531

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.
- 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 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 22 Plumbing, as applicable
 - 3. Division 26 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
for Piping Components | Specification for Forgings, Carbon Steel |
| 4. | ASTM A 193
Steel Bolting Materials for High Temperature Service | Specification for Alloy Steel and Stainless |
| 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

Centers | Nameplates, Labels, and Tags for Control |
| 8. | ISA-RP7.1 | Pneumatic Control Circuit Pressure Test |
| 9. | ISA-RP12.6
for Hazardous (Classified) Locations | Installation of Intrinsically Safe Systems |
| 10. | ISA-S5.1 | Instrument Symbols and Identification |
| 11. | ISA-S5.4 | Instrument Loop Diagrams |
| 12. | ISA-S12.4
Hazardous Area Classification | Instrument Purging for Reduction of |
| 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 Fittings, 3-In Through	Ductile-Iron and Gray-Iron
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. Pre-submittal Conference:

1. The CONTRACTOR shall arrange and conduct a Pre-submittal Conference within 60 days after Notice to Proceed. The purpose of the Pre-submittal 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 8 hours 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 Pre-submittal 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 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 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. 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

5. Installation, mounting, and anchoring details for all components and assemblies to be field mounted, including conduit connection or entry details.
6. 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, hand stations, 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 OWNER'S MANUAL

- A. Information included in the OWNER'S MANUAL shall comply with the requirements of Section 01300 with the following exceptions:
 1. Two copies of the OWNER'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 OWNER'S MANUAL, after revision, shall be submitted to the CONSTRUCTION MANAGER 15 days prior to startup.
- B. The following shall be included in the OWNER'S MANUAL in accordance with Section 01300:
 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 prepared in accordance with Section 01300 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 22, and 26 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 OWNER'S use.
 3. Drawings shall also be submitted in electronic format AUTOCAD.

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 OWNER'S Personnel:** The manufacturer's technical service representative shall instruct the OWNER'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 OWNER.

1.10 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.

1.11 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:** 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 OWNER, devices shall be replaced in order to achieve a maximum level of 55 db or sound absorption materials shall be added.

1.12 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 and loop number).
- 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 fault tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. All power supplies shall have an excess rated capacity of 40 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. Control panel shall be stainless enclosure mounted on stands, with double doors, removable backplane, user foldable tray, and with maximum height of six (6) feet. No side or top conduit perforations allowed.
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.
- 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-foot 6-inches wide or five 2-foot 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 downstream 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 1/2-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 LED type 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, 15 ampere, duplex receptacle for every 4 feet of panel width spaced evenly along the back-of-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 LED 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 120-volt circuits shall be No. 12 AWG stranded with Type THHN/THWN-2 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 THHN/THWN-2 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
- 2. 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:

1. 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).
2. 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 NOT be used for attaching nameplates. Nameplates shall be mounted using stainless steel machine screws. Nameplates shall be fabricated from black face white-center laminated engraving plastic. 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 OWNER 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 24 volts DC; 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. **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.
- D. **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 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
LIT-1A	I-1	Reservoir Level	0-20 psi	4X

PIT-10	I-1	Discharge Pressure	0-150 psi	4X

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 solids, 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 1/4-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, 1/2-inch inlet, 1/4-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
PI-1	SUCTION PRESS		0-50 PSI
PI-2	SUCTION PRESS		0-50 PSI
PI-3	SUCTION PRESS		0-50 PSI
PI-4	SUCTION PRESS		0-50 PSI

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- C. Diaphragm Seals for Pressure Measuring Systems: Diaphragm seals shall consist of bottom housing, lower ring, and 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 instrument's 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.

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 Required
PSL-1	I-2	SUCTION PRESS	TBD	4X SS	No
PSH-1	I-2	DISCHARGE PRESS	TBD	4X SS	No
PSL-2	I-2	SUCTION PRESS	TBD	4X SS	No
PSH-2	I-2	DISCHARGE PRESS	TBD	4X SS	No
PSL-3	I-1	SUCTION PRESS	TBD	4X SS	No
PSH-3	I-1	DISCHARGE PRESS	TBD	4X SS	No
PSL-4	I-1	SUCTION PRESS	TBD	4X SS	No
PSH-4	I-1	DISCHARGE PRESS	TBD	4X SS	No

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. The RTD 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 Integral/Remote	NEMA Rating
TIT-1A	I-1	Reservoir Upper Level	0-100 F	Remote	4X
TIT-1B	I-1	Reservoir Mid Level	0-100 F	Remote	4X
TIT-1C	I-1	Reservoir Low Level	0-100 F	Remote	4X

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 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 I/O 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 program shall be standard IEC 61131-3 in Unity Pro XL. The Custom PLC control application shall be written in Derived Function Block DFB. A SAMPLE ONLY, not to be used program, shall be provided as a reference. The PLC shall be easily reprogrammed with a portable programming unit or laptop computer. 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 operate at 24VDC. 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. Output modules shall operate at 24VDC. The output modules shall be fused

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 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 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. **Programming Unit:** All programming shall be accomplished with a laptop computer. . 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 laptop. 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 OWNER to enable future system support. The device shall be turned over to the OWNER at START-UP.

K. **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 and 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 least 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.

- L. **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 OWNER'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. **Operation and Maintenance Manuals:** The CONTRACTOR shall furnish to the OWNER 5 complete sets of operation and maintenance manuals. The manuals shall include data, 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 OWNER.

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 OWNER 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 26. 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 26 and be terminated and identified under Division 13.

- 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 OWNER.
- H. All instruments shall be located and installed for ready access by the OWNER'S operation and maintenance staff. The OWNER reserves the right to require minor changes in location of equipment prior to roughing without any additional cost to the OWNER.

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 megohmmeter 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 260533. 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 or RTD 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 designated operators 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 OWNER.
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 manufacturer's representatives as required during the testing period required in Section 01660 to produce a fully operational system.
- F. **Instruction:** The CONTRACTOR shall train the OWNER'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. Instructors shall have training experience.
 - 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 OWNER personnel that attended the lesson.
 - b. An evaluation of OWNER personnel knowledge through written testing or equivalent.
 - c. A copy of text utilized during the lesson with all notes, diagrams, and comments.

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 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.

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SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.
- C. EMT: Electrical Metal Tubing

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. AFC Cable Systems; a part of Atkore International.
 2. Allied Tube & Conduit; a part of Atkore International.
 3. Electri-Flex Company.
 4. O-Z/Gedney; a brand of Emerson Industrial Automation.

5. Western Tube and Conduit Corporation.
 6. Or Equal.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- G. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. AFC Cable Systems; a part of Atkore International.
 2. Anamet Electrical, Inc.
 3. Arnco Corporation.
 4. Condux International, Inc.
 5. RACO; Hubbell.
 6. Or Equal.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

- D. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Crouse-Hinds, an Eaton business.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman; a brand of Pentair Equipment Protection.
 - 5. Hubbell Incorporated.
 - 6. RACO; Hubbell.
 - 7. Thomas & Betts Corporation; A Member of the ABB Group.
 - 8. Or Equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

2.4 HAZARDOUS LOCATIONS

- A. Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70: specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations: as indicated. Equipment in hazardous locations: comply with UL 1203 for electrical equipment and industrial controls and UL 674 for motors.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-40-PVC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: PVC coated GRC.
 2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 3. Damp or Wet Locations: PVC coated GRC.
 4. Boxes and Enclosures: Explosion proof.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

- A. Hazardous Locations: Perform work in hazardous locations, as defined by NFPA 70, in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Provide conduit with tapered threads.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.

- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where an underground service raceway enters a building or structure.
 - 2. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.

- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- W. Locate boxes so that cover or plate will not span different building finishes.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

*****END OF SECTION*****

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SECTION 260543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS **PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Direct-buried conduit, ducts, and duct accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including separators and miscellaneous components.
 - 2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.

2.2 CONDUIT

- A. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.
- B. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. ARNCO Corp.
 2. CANTEX INC.
 3. Condux International, Inc.
 4. Electri-Flex Company.
 5. Or Equal.
- B. Solvents and Adhesives: As recommended by conduit manufacturer.
- C. Duct Accessories:
 1. Warning Tape: Underground-line warning tape specified in Section 26 05 53 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by the Resident Engineer.

3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Section 02200 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

- C. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 01 73 00 "Execution."

3.4 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition.
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf-test nylon cord in empty ducts.
- H. Direct-Buried Duct Banks:
 - 1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 31 20 00 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
 - 2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 - 3. Depth: Install top of duct bank at least 36 inches below finished grade unless otherwise indicated.
 - 4. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
 - 5. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - 6. Install manufactured PVC jacketed rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

- b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
- 7. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 31 20 00 "Earth Moving" for installation of backfill materials.
 - a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
- I. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch-long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

*****END OF SECTION*****

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification of power and control cables.
2. Identification for conductors.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels, including arc-flash warning labels.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 TAPES AND STENCILS:

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Underground-Line Warning Tape

1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

2.3 SIGNS

- A. Baked-Enamel Signs:
 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal Size: 7 by 10 inches.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Engraved, Laminated Acrylic or Melamine Label: Black letters on a white background. Minimum letter height shall be 3/8 inch (10 mm). Drilled for fasteners.
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

- B. Verify identity of each item before installing identification products.
- C. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- G. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

3.3 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.
- C. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.
1. Comply with NFPA 70E and ANSI Z535.4.
 2. Comply with Section 26 05 74 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- D. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment To Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Motor-control centers.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Push-button stations.

*****END OF SECTION*****

SECTION 260563

UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes materials and installation of a complete uninterruptible power supply system for critical loads including but not limited to programmable logic controllers, instrumentation and telemetry systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Process Instrumentation and Control System: 260530

1.3 SUBMITTALS

- 1. Submit ratings and characteristics including voltage, connection, enclosure type and dimensions, and conduit entry restrictions.

PART 2 - MATERIALS

2.1 GENERAL REQUIREMENTS

- A. The UPS system shall be designed to protect the PLC, instruments, and telemetry system from line disturbance, subcycle power losses, and power outages. In normal operation the UPS shall supply filtered and regulated ac power to the load. Upon failure of the commercial ac power, the critical load shall continue to be supplied by the inverter, which shall obtain its power from the battery.
- B. The interruption to the critical load upon failure or restoration of the commercial ac source shall not exceed 4 milliseconds. Upon restoration of the commercial source, the inverter/charger shall recharge the battery.
- C. An external manually operated switch shall be provided to transfer the load to the bypass line with a safety interlock to prevent the load from being transferred back during servicing.

2.1 2.2 UNINTERRUPTIBLE POWER SUPPLY UNIT

- A. The UPS shall be complete with power indication, common alarm dry contact and running status dry contacts from relay output cards, and inverter circuit breaker protection.
- B. External batteries shall be sealed leak proof and maintenance free, and mounted adjacent to the UPS main unit.
- C. The UPS unit shall be mounted in a freestanding cabinet provided by the manufacturer or in PLC cabinet as shown on drawings.
- D. The UPS system shall meet the following requirements:
 - 1. Input/output voltage: 120 volts ac, single phase, 60 Hz.
 - 2. Minimum output rating:

- a. Pump station panel: 1500 VA
 - b. Provide higher rating as required based on specified equipment and minimum operating time requirement (see below for time requirement).
3. Output Harmonic Distortion: 5 percent maximum at full load.
 4. Frequency stability: +/- 0.5 percent.
 5. Voltage regulation for line and load: +/-2 percent.
 6. Overload capacity: 125 percent for 3 seconds.
 7. Full recharge time: 48 hours.
 8. Battery lifetime: 3 years at ambient temperature 45 C.
 9. Isolation/maintenance bypass switch.
 10. A relay output card to enable monitoring via dry contacts the RUN and FAIL status of the unit
 11. The UPS system shall be capable of delivering power to the connected load for the minimum time duration of 4 hours for pump station.
 12. The UPS system shall be APC Cat. BR1500G or as approved.

PART 3 EXECUTION

3.1 GENERAL

- A. Install the UPS system in the designated location according to manufacturer's instructions.

3.2 UPS STATUS MONITORING

- A. UPS Alarm: This contact shall be closed when the UPS is normal and open when the is in an alarm state.

3.3 TERMINAL BLOCKS

- A. .Wiring for external circuits, including the alarm contact, shall be brought to grouped terminal blocks located for convenient connection. Provisions shall include suitable marked terminal blocks for connection of 12 AWG copper wire. Terminal designations shall agree with the manufacturer's wiring diagram.

3.4 FUNCTIONAL TESTS

- A. Upon installation of the UPS system, the supplier shall conduct on-site functional testing which shall include a minimum of 10 transfer-retransfer cycles. The UPS supplier shall inform the Owner and Engineer of the onsite test schedule so that the test may be witnessed by the Owner and Engineer.

*****END OF SECTION *****

SECTION 262413

SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Disconnecting and overcurrent protective devices.
 - 3. Accessory components and features.
 - 4. Identification.

1.3 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - 6. Detail utility company's metering provisions with indication of approval by utility company.
 - 7. Include evidence of NRTL listing for series rating of installed devices.
 - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent

log-log graft paper; include selectable ranges for each type of overcurrent protective device.

10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For switchboards, overcurrent protective devices, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
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.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01730 "Operation and Maintenance Information," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400 and NEMA PB 2.1.

1.9 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 1. Do not deliver or install switchboards without available storage spaces that are enclosed and weathertight.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- C. Unusual Service Conditions: NEMA PB 2, as follows:

1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify City of Coronado Project Manager or Fire Station Chief no fewer than seven days in advance of proposed interruption of electric service.
 2. Utilize existing gas fired generator in providing temporary power to Stand-by Loads .
 3. Do not proceed with interruption of electric service without City of Coronado Project Manager or Fire Station Chief written permission.
 4. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete. See Structural drawing S1.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Siemens Power Transmission & Distribution, Inc.
 - 4. Square D; by Schneider Electric.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
- I. Nominal System Voltage: 208Y/120 V.
- J. Main-Bus Continuous: 400 A.
- K. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces.
 - 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 the seismic forces specified and the unit will be fully operational after the seismic event."
- L. Outdoor Enclosures: NEMA 4X-stainless steel.
 - 1. Enclosure: roof; for each section, with provisions for padlocking.
 - 2. Accessories: Ground-fault circuit interrupter (GFCI) duplex receptacle.
- M. Barriers: Between adjacent switchboard sections.
- N. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

- O. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
 - 1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
 - 2. Space-Heater Power Source: Transformer, factory installed in switchboard.
- P. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- Q. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- R. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- S. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- T. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 - 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
 - 3. Copper feeder circuit-breaker line connections.
 - 4. Ground Bus: 1/4-by-2-inch or Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors.
 - 5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 6. Disconnect Links:
 - a. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 - 7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 - 8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- U. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

- V. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
 - c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - d. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - e. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - f. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

2.5 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400 and NEMA PB 2.1.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.

3. Protect from moisture, dust, dirt, and debris during storage and installation.
 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
 - C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
 - D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in structural drawings S1 and S2.
 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install spare-fuse cabinet.
- G. Comply with NECA 1.

3.3 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Perform the following infrared scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- B. Switchboard will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.6 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- 3.7 PROTECTION
- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

*****END OF SECTION*****

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.
 - 5. Short-circuit current rating of panelboards and overcurrent protective devices.

6. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01730 "Operation and Maintenance Information," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

- b. Back Boxes: Same finish as panels and trim.
- G. Incoming Mains:
 - 1. Location: Top.
 - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Eaton.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. Siemens Energy.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Eaton.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. Siemens Energy.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.

- b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. MCCB Features and Accessories:
- a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- I. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- K. Install filler plates in unused spaces.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- B. Panelboards will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

*****END OF SECTION*****

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SECTION 262419

MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes MCCs for use with ac circuits rated 600 V and less and having the following factory-installed components:
 - 1. Incoming main lugs and OCPDs.
 - 2. Full-voltage magnetic controllers.
 - 3. Reduced-voltage, solid-state controllers.
 - 4. Variable frequency controller
 - 5. Feeder-tap units.
 - 6. TVSS.
 - 7. Instrumentation.
 - 8. Auxiliary devices.

1.3 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. GFCI: Ground fault circuit interrupting.
- F. IGBT: Insulated-gate bipolar transistor.
- G. LAN: Local area network.
- H. LED: Light-emitting diode.
- I. MCC: Motor-control center.
- J. MCCB: Molded-case circuit breaker.
- K. MCP: Motor-circuit protector.
- L. NC: Normally closed.
- M. NO: Normally open.

- N. OCPD: Overcurrent protective device.
- O. PCC: Point of common coupling.
- P. PID: Control action, proportional plus integral plus derivative.
- Q. PT: Potential transformer.
- R. PWM: Pulse-width modulated.
- S. RFI: Radio-frequency interference.
- T. SCR: Silicon-controlled rectifier.
- U. TDD: Total demand (harmonic current) distortion.
- V. THD(V): Total harmonic voltage demand.
- W. TVSS: Transient voltage surge suppressor.
- X. VFC: Variable-frequency controller.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: MCCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of controller and each type of MCC. Include shipping and operating weights, features, performance, electrical ratings, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each MCC, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
 - f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.

- g. Specified optional features and accessories.
- 2. Schematic Wiring Diagrams: For power, signal, and control wiring for each installed controller.
- 3. Nameplate legends.
- 4. Vertical and horizontal bus capacities.
- 5. Features, characteristics, ratings, and factory settings of each installed unit.

1.6 INFORMATIONAL SUBMITTALS

- A. Standard Drawings: For each MCC, as defined in UL 845.
- B. Production Drawings: For each MCC, as defined in UL 845.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around MCCs where pipe and ducts are prohibited. Show MCC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Seismic Qualification Certificates: For MCCs, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 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.
- E. Product Certificates: For each MCC, from manufacturer.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.
- J. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01730 "Operation and Maintenance Information," include the following:

1. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage, solid-state controllers.
5. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
6. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- 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. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: Two of each type and color installed.
 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.

- B. Handle MCCs according to the following:
 - 1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
 - 2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."
- C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; connect factory-installed space heaters to temporary electrical service.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - 3. Humidity: Less than 95 percent (noncondensing).
- B. Interruption of Existing Electrical Service or Distribution Systems: Do not interrupt electrical service to, or distribution systems within, a facility occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of electrical service.
 - 2. Indicate method of providing temporary electrical service.
 - 3. Do not proceed with interruption of electrical service without Owner's written permission.
 - 4. Comply with NFPA 70E.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for MCCs, including clearances between MCCs and adjacent surfaces and other items.

1.12 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.
- B. Coordinate features of MCCs, installed units, and accessory devices with remote pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each MCC, each controller, and each installed unit with ratings and characteristics of supply circuits, motors, required control sequences, and duty cycle of motors and loads.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB; Control Products.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Industrial Systems.
4. Rockwell Automation, Inc.; Allen-Bradley Brand.
5. Square D; a brand of Schneider Electric.

B. General Requirements for MCCs: Comply with NEMA ICS 18 and UL 845.

2.2 FUNCTIONAL FEATURES

A. Description: Modular arrangement of main units, controller units, control devices, feeder-tap units, instruments, metering, auxiliary devices, and other items mounted in vertical sections of MCC.

B. Controller Units: Combination controller units.

1. Install units up to and including Size 3 on draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
2. Equip units in Type B and Type C MCCs with pull-apart terminal strips for external control connections.

C. Feeder-Tap Units: Through 225-A rating shall have draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

D. Future Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of draw-out units.

E. Spare Units: Installed in compartments indicated "spare."

2.3 INCOMING MAINS

A. Incoming Mains Location: bottom.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
4. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

2.4 COMBINATION CONTROLLERS

- A. Full-Voltage Controllers:
 1. General Requirements for Full-Voltage Enclosed Controllers: Comply with NEMA ICS 2, general purpose, Class A.
 2. Magnetic Controllers: Full voltage, across the line, electrically held.
 - a. Configuration: Non-reversing.
- B. Reduced-Voltage, Solid-State Controllers:
 1. General Requirements for Reduced-Voltage, Solid-State Controllers: Comply with UL 508.
 2. Reduced-Voltage, Solid-State Controllers: An integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium-induction motors.
 - a. Configuration: Standard duty; nonreversible.
 - b. Starting Mode: Voltage ramping, current limiting.
 - c. Stopping Mode: Coast to stop.
 - d. Shorting (Bypass) Contactor: Operates automatically when full voltage is applied to motor, and bypasses the SCRs. Solid-state controller

protective features shall remain active when the shorting contactor is in the bypass mode.

- e. Shorting and Input Isolation Contactor Coils: Pressure-encapsulated type; manufacturer's standard operating voltage, matching control power or line voltage, depending on contactor size and line-voltage rating.
- f. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
- g. Adjustable acceleration-rate control using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.
- h. SCR bridge shall consist of at least two SCRs per phase, providing stable and smooth acceleration with external feedback from the motor or driven equipment.
- i. Keypad, front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:
- j. Adjusting motor full-load amperes, as a percentage of the controller's rating.
- k. Adjusting current limitation on starting, as a percentage of the motor full-load current rating.
- l. Adjusting linear acceleration and deceleration ramps, in seconds.
- m. Initial torque, as a percentage of the nominal motor torque.
- n. Adjusting torque limit, as a percentage of the nominal motor torque.
- o. Adjusting maximum start time, in seconds.
- p. Adjusting voltage boost, as a percentage of the nominal supply voltage.
- q. Selecting stopping mode, and adjusting parameters.
- r. Selecting motor thermal-overload protection class between 5 and 30.
- s. Activating and de-activating protection modes.
- t. Selecting or activating communications modes.
- u. Digital display, front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:
- v. Controller Condition: Ready, starting, running, stopping.
- w. Motor Condition: Amperes, voltage, power factor, power, and thermal state.

- x. Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted SCRs, line or phase loss, phase reversal, and line frequency over or under normal.
 - y. Controller Diagnostics and Protection:
 - z. Microprocessor-based thermal protection system for monitoring SCR and motor thermal characteristics, and providing controller over temperature and motor overload alarm and trip; settings selectable via the keypad.
 - aa. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency over or under normal.
 - bb. Input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component, or when the motor is stopped.
 - cc. Remote Output Features:
 - dd. All outputs prewired to terminal blocks.
 - ee. Form C status contacts that change state when controller is running.
 - ff. Form C alarm contacts that change state when a fault condition occurs.
 - gg. Optional Features:
 - hh. Analog output for field-selectable assignment of motor operating characteristics; 4 to 20-mA dc.
 - ii. Additional field-assignable Form C contacts for alarm outputs.
 - jj. Surge suppressors in solid-state power circuits providing three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - kk. Full-voltage bypass contactor operating automatically. Power contacts shall be totally enclosed, double break, and silver-cadmium oxide; and assembled to allow inspection and replacement without disturbing line or load wiring.
- C. Disconnecting Means and OCPDs:
- 1. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
- D. Overload Relays:

1. Solid-State Overload Relays:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 2. NO isolated overload alarm contact.
 3. External overload reset push button.
- E. Control Power:
1. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 200 VA.

2.5 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
1. PTs: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 3. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Listed or recognized by a nationally recognized testing laboratory.
 2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.

- e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.6 ENCLOSURES

- A. Outdoor Enclosures: Type 3R, non-walk-in aisle.
 - 1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 - 2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.
 - 3. Doors: Personnel door at each end of aisle, minimum width of 30 inches; opening outwards; with panic hardware and provisions for padlocking.
- B. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
- C. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- D. Wiring Spaces:
 - 1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
 - 2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

2.7 AUXILIARY DEVICES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.
 - a. Push Buttons: Recessed types; momentary contact unless otherwise indicated.
 - b. Pilot Lights: LED types; push to test.

- c. Selector Switches: Rotary type.
- 2. Elapsed-Time Meters: Heavy duty with digital readout in hours; non-resettable.
- B. NO contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Terminals for connecting power factor correction capacitors to the load side of overload relays.
- F. Spare control-wiring terminal blocks; wired.

2.8 CHARACTERISTICS AND RATINGS

- A. Wiring: NEMA ICS 18, Class II-S, Type B, for starters above Size 3.
- B. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
- C. Nominal System Voltage: 480Y/277 V, three phase, four wire.
- D. Short-Circuit Current Rating for Each Unit: Fully rated; 42 kA.
- E. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 42 kA.
- F. Environmental Ratings:
 - 1. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 104 deg F, with an average value not exceeding 95 deg F over a 24-hour period.
 - 2. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
 - 3. Humidity Rating: Less than 95 percent (noncondensing).
 - 4. Altitude Rating: Not exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.
- G. Main-Bus Continuous Rating: 800 A.
- H. Vertical-Bus Continuous Rating: 300 A.
- I. Horizontal and Vertical Bus Bracing (Short-Circuit Current Rating): Match MCC short-circuit current rating.
- J. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions from both ends.
- K. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
- L. Phase Bus Material: Hard-drawn copper of 98 percent conductivity, tin plated.

- M. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.
 - N. Ground Bus: Minimum size required by UL 845, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit equipment grounding conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - O. Front-Connected, Front-Accessible MCCs:
 - 1. Main Devices: Fixed mounted.
 - 2. Controller Units: fixed mounted.
 - 3. Feeder-Tap Units: fixed mounted.
 - 4. Sections front and rear aligned.
 - P. Bus Transition and Incoming Pull Sections: Matched and aligned with basic MCC.
 - Q. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of unit.
 - R. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
 - S. Fungus Proofing: Permanent fungicidal treatment for OCPDs and other components including instruments and instrument transformers.
- 2.9 SOURCE QUALITY CONTROL
- A. MCC Testing: Inspect and test MCCs according to requirements in NEMA ICS 18.
 - B. MCCs will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of MCCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Floor-Mounting Controllers: Install MCCs on 4-inch nominal thickness concrete base.

1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible switch.
- E. Install fuses in control circuits if not factory installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label MCC and each cubicle with engraved nameplate.
 3. Label each enclosure-mounted control and pilot device.
 4. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.
- B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central-control system. Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

- A. Comply with requirements for installation of conduit in Section 26 05 33 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test insulation resistance for each enclosed controller element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Verify that voltages at controller locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
 5. Test each motor for proper phase rotation.
 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 9. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

- A. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.
- B. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage, solid-state controllers.

*****END OF SECTION*****

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
 - 2. GFCI receptacles.
 - 3. Toggle switches.
 - 4. Wall plates.

1.3 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
 - 1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
 - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
 - 3. Leviton: Leviton Mfg. Company, Inc.
 - 4. Pass & Seymour: Pass& Seymour/Legrand.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.
- H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.

2.3 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, non-feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.

3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.

2.4 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
1. Single Pole:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 2. Three Way:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.

2.5 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.6 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective

devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- B. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

*****END OF SECTION*****

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SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.
- D. DPDT: Double pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Manufacturer's field service report.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.9 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company.

3. Siemens Industry, Inc.
 4. Or Equal.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clip or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Lugs: Mechanical type, suitable for number, size, and conductor material.
 4. Class R Fuse Kit: Provides rejection of other fuses when Class R fuses are specified.

2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Hazardous Areas Indicated on Drawings: NEMA 250.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

*****END OF SECTION*****

SECTION 263600

TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes nonautomatic transfer switches rated 600 V and less, including the following:
 - 1. Bypass/isolation switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.
 - 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer-authorized service representative.
- B. Seismic Qualification Certificates: For transfer switches, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 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.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01, include the following:

- a. Features and operating sequences, both automatic and manual.
- b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

- a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 99.

D. Comply with NFPA 110.

E. Comply with UL 1008 unless requirements of these Specifications are stricter.

F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

G. Service-Rated Transfer Switch:

1. Comply with UL 869A and UL 489.

2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.

3. In systems with a neutral, the bonding connection shall be on the neutral bus.

4. Provide removable link for temporary separation of the service and load grounded conductors.
 5. Service Disconnecting Means: Externally operated, manual mechanically actuated.
- H. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- I. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- J. Battery Charger: For generator starting batteries.
1. Float type, rated 2 A.
 2. Ammeter to display charging current.
 3. Fused ac inputs and dc outputs.
- K. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 NONAUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ASCO Power Technologies, LP; a business of Emerson Network Power.
 2. Eaton.
- B. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- C. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- D. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- E. Pilot Lights: Indicate source to which load is connected.
- F. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.
1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."
- G. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

- H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching.
 - 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 4. Material: Hard-drawn copper, 98 percent conductivity.
 - 5. Main and Neutral Lugs: Mechanical type.
 - 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 7. Ground bar.
 - 8. Connectors shall be marked for conductor size and type according to UL 1008.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
 - 2. Comply with requirements for seismic control devices.
 - 3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 4. Provide workspace and clearances required by NFPA 70.
- B. Identify components according to Section 26 05 53 "Identification for Electrical Systems."
- C. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- E. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.

- D. Coordinate tests with tests of generator and run them concurrently.
- E. 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.
- F. Transfer switches will be considered defective if they do not pass tests and inspections.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

*****END OF SECTION*****

SECTION 265119

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Lighting luminaires.
 - 2. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 - 3. Structural members to which luminaires will be attached.
 - 4. Initial access modules for acoustical tile, including size and locations.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of luminaire.
- F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

- D. Bulb shape complying with ANSI C79.1.
- E. CRI of minimum 80. CCT of 4100 K.
- F. Rated lamp life of 50,000 hours.
- G. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- J. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear powder-coat finish.

2.3 LINEAR INDUSTRIAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Lighting, an Eaton business.
 - 2. Lighting Science Group.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Minimum 5,000 lumens. Minimum allowable efficacy of 80 lumens per watt.
- C. Housing and heat sink rated to the following:
 - 1. Class 1, Division 1 Group(s) C and D.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Tempered borosilicate glass tubes
- D. Housings:
 - 1. Heavy duty housing and end caps, copper-free aluminum.

2. 316 Stainless Steel external hardware.
 3. Clear powder-coat finish.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Supports:
 1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.
 3. Provide support for luminaire without causing deflection of ceiling or wall.
 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

- D. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
- E. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

*****END OF SECTION*****

SECTION 265613

LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete lighting fixture.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Include finishes for lighting poles and luminaire-supporting devices.
 - 3. Anchor bolts.
 - 4. Manufactured pole foundations.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
 - 4. Anchor bolt templates keyed to specific poles and certified by manufacturer.
 - 5. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.
- B. Qualification Data: For Installer and testing agency.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Pole repair materials.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
 - 2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design pole foundations and pole power systems, per Section 01300 "Contractor Submittals,"

- B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.
- C. Structural Characteristics: Comply with AASHTO LTS-6-M.
- D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- E. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
 - 1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factor: 1.0.
- G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 ALUMINUM POLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Lighting, an Eaton business.
 - 2. Hubbell Incorporated.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6063-T6, with access handhole in pole wall.
 - 1. Shape: Square, straight.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

- D. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- H. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Powder coat shall comply with AAMA 2604.
 - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: As selected by Architect from manufacturer's full range.

2.3 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Threading: Uniform National Coarse, Class 2A.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F 436, Type 1.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2. Two washers provided per anchor bolt.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Division 03.
- B. Anchor Bolts: Install plumb using manufacturer-supplied plywood template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
 1. Fire Hydrants and Water Piping: 60 inches.
 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
 3. Trees: 15 feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03.
- D. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge

of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

- E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
 - 2. System function tests.

*****END OF SECTION*****

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SECTION 265619

LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 26 56 13 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-80.

- a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
- 6. Wiring diagrams for power, control, and signal wiring.
- 7. Photoelectric relays.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For luminaire supports.
 - 1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Structural members to which equipment and luminaires will be attached.
 - 3. Underground utilities and structures.
 - 4. Existing underground utilities and structures.
 - 5. Above-grade utilities and structures.
 - 6. Existing above-grade utilities and structures.
 - 7. Building features.
 - 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 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.

- D. Product Certificates: For each type of the following:
 - 1. Luminaire.
 - 2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Source quality-control reports.
- G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. Lamp base complying with ANSI C81.61.
- E. Bulb shape complying with ANSI C79.1.
- F. CRI of minimum 80. CCT of 4100 K.
- G. L70 lamp life of 50,000 hours.
- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.

- I. Internal driver.
- J. Nominal Operating Voltage: 120 V ac.
- K. In-line Fusing: Separate in-line fuse for each luminaire.
- L. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- M. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Lighting, an Eaton business.
 - 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 3. Philips Lighting Company.
- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

- A. Area and Site:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Lighting, an Eaton business.
 - b. Lightolier; a Philips group brand.
 - c. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. Luminaire Shape: Square.
 - 3. Mounting: Pole with extruded-aluminum arm, 11 inches in length.
 - 4. Distribution: Type II, Type III, or as indicated in the luminaire schedule.
 - 5. Diffusers and Globes: Clear glass.
 - 6. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Clear powder-coat finish.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum Epoxy-coated steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.6 FINISHES

- A. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and - tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

*****END OF SECTION*****

SECTION 282300

VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. B/W: Black and white.
- D. CCD: Charge-coupled device.
- E. FTP: File transfer protocol.
- F. IP: Internet protocol.
- G. LAN: Local area network.
- H. MPEG: Moving picture experts group.
- I. NTSC: National Television System Committee.
- J. PC: Personal computer.
- K. PTZ: Pan-tilt-zoom.
- L. RAID: Redundant array of independent disks.
- M. TCP: Transmission control protocol - connects hosts on the Internet.
- N. UPS: Uninterruptible power supply.
- O. WAN: Wide area network.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
 - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
 - 4. UPS: Sizing calculations.
 - 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Design Data: Include an equipment list consisting of every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for cameras, camera-supporting equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 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.
- B. Field quality-control reports.
- C. Product Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following:
 - 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
 - 2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
 - 3. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 3R enclosures.
 - 4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph. Use NEMA 250, Type 3R enclosures.
 - 5. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.
 - 6. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
 - 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."
 - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 STANDARD CAMERAS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Bosch Security Systems, Inc.
 - 2. Hitachi, Ltd.
 - 3. Honeywell Security Products- Americas.
 - 4. Vicon Industries, Inc.
- B. B/W Camera:
 - 1. Comply with UL 639.
 - 2. Pickup Device: CCD interline transfer, 252,000 512(H) by 492(V) pixels.
 - 3. Horizontal Resolution: 380 lines.
 - 4. Signal-to-Noise Ratio: Not less than 46 dB.
 - 5. With AGC, manually selectable on or off.
 - 6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
 - 7. Manually selectable modes for backlight compensation or normal lighting.

8. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
 9. Motion Detector: Built-in digital.
- C. Color Camera:
1. Comply with UL 639.
 2. Pickup Device: CCD interline transfer, 380,000 771(H) by 492(V) pixels.
 3. Horizontal Resolution: 480 lines.
 4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
 5. With AGC, manually selectable on or off.
 6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
 7. Manually selectable modes for backlight compensation or normal lighting.
 8. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
 9. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
 10. Motion Detector: Built-in digital.
- D. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.
1. Comply with UL 639.
 2. Pickup Device: CCD interline transfer, 380,000 768(H) by 494(V) pixels.
 3. Horizontal Resolution: 480 lines.
 4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
 5. With AGC, manually selectable on or off.
 6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
 7. Manually selectable modes for backlight compensation or normal lighting.
 8. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.
 9. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:

- a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
 - b. Motion detection shall be available at each camera position.
 - c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.
10. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
 11. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
 12. Motion Detector: Built-in digital.
 13. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

2.3 LENSES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Bosch Security Systems, Inc.
 2. Hitachi, Ltd.
 3. Vicon Industries, Inc.
- B. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.
 1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
 2. Fixed Lens: With calibrated focus ring.
 3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:
 - a. Electrical Leads: Filtered to minimize video signal interference.
 - b. Motor Speed: Variable.
 - c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.4 POWER SUPPLIES

- A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera, infrared illuminator, and lens.

1. Enclosure: NEMA 250, Type 3.

2.5 INFRARED ILLUMINATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Honeywell Security Products- Americas.
 2. International Space Optics.
 3. Merit Li-Lin (USA) Corp.
 4. Visiontech.
- B. Description: Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.
 1. Field-Selectable Beam Patterns: Narrow, medium, and wide.
 2. Rated Lamp Life: More than 8000 hours.
 3. Power Supply: 120-V ac.
- C. Area Coverage: Illumination to 150 feet in a narrow beam pattern.
- D. Exterior housings shall be suitable for same environmental conditions as the associated camera.

2.6 CAMERA-SUPPORTING EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Bosch Security Systems, Inc.
 2. Vicon Industries, Inc.
- B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.
- C. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.
 1. Scanning Operation: Silent, smooth, and positive.
 2. Stops: Adjustable without disassembly, to limit the scanning arc.
- D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.
 1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
 2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.

3. Speed: 12 degrees per second in both horizontal and vertical planes.
 4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
 5. Built-in encoders or potentiometers for position feedback, and thermostat-controlled heater.
 6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.
- E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.
- F. Protective Housings for Fixed and Movable Cameras: Steel or 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.
1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display.
 2. Camera Viewing Window: Lexan window, aligned with camera lens.
 3. Duplex Receptacle: Internally mounted.
 4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
 5. Built-in, thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
 6. Sun shield shall not interfere with normal airflow around the housing.
 7. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
 8. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.

2.7 DIGITAL SWITCHERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Bosch Security Systems, Inc.
 2. Pelco.
 3. Toshiba Corporation.
- B. Quad Switch: For displaying images from four cameras on a single monitor. Provide color switcher if one or more cameras or monitors are in color.

1. Controls: Unit-mounted front panel.
 2. Resolution: 720 by 480 lines.
 3. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.
 4. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.
 5. Time: Indicate date and time.
 6. Timing of Auto-Switcher: 1 to 30 seconds, selectable.
 7. Mounting: Standard 19-inch rack complying with CEA 310-E, or freestanding desktop.
- C. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.
- D. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.
1. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.
 2. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.
 3. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.
 4. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.
 5. Mounting: Standard 19-inch rack complying with CEA 310-E.
- E. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.
1. Pan-and-Tilt Control: Joystick type.
 2. Zoom Control: Momentary-contact, "in-out" push button.
 3. Automatic-Scan Control: A push button for each camera with pan capability that places camera in automatic-scanning mode.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

- A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
 - 1. Except raceways are not required in accessible indoor ceiling spaces and attics.
 - 2. Except raceways are not required in hollow gypsum board partitions.
 - 3. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 84-inch-minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
- E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- F. Avoid ground loops by making ground connections only at the control station.
 - 1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.
- G. Identify system components, wiring, cabling, and terminals according to Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
 2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
 - a. Prepare equipment list described in "Informational Submittals" Article.
 - b. Verify operation of auto-iris lenses.
 - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
 - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
 - e. Set and name all preset positions; consult Owner's personnel.
 - f. Set sensitivity of motion detection.
 - g. Connect and verify responses to alarms.
 - h. Verify operation of control-station equipment.
 3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- C. Video surveillance system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
1. Check cable connections.
 2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
 3. Adjust all preset positions; consult Owner's personnel.

4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

*****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 92101-2400

FROM: City of San Diego
Public Works Department
525 B Street, Suite 750, MS 908A
San Diego, CA 92101

 Office of Planning and Research
1400 Tenth Street, Room 121
Sacramento, CA 95814

Project Name: Soledad Pump Station

Project No. / SCH No.: 440276

Project Location-Specific: Southwest corner of La Jolla Scenic Drive and Via Casa Alta (APN 352-310-4000)

Project Location-City/County: San Diego/San Diego

Description of nature and purpose of the Project: The Soledad Pump Station project proposes the construction of a new 1,387 square foot (SF) pump station building, inlet/outlet piping, tank mixing system, surge tank, miscellaneous tank improvements, landscaping, miscellaneous pump station upgrades, electrical work, street resurfacing, and site resurfacing. The project site is a 35,025 SF parcel with a sloped topography within the La Jolla Community Plan, and Council District 1.

The new pump station building will be constructed adjacent to the existing 280 SF pump station building on the eastern side of the parcel. It will also encroach a maximum of 14 feet into the required 25 foot rear yard setback required by the development regulations of the RS-1-2 zone. Because of site constraints, the project site cannot be redesigned to meet this requirement; however, findings can be made pursuant to City Administrative Regulations 1.60 to allow this Capital Improvement Project (CIP) to deviate from the development regulations of the RS-1-2 zone.

Name of Public Agency Approving Project: City of San Diego

Name of Person or Agency Carrying Out Project: Gretchen Eichar, Senior Planner; 525 B Street, San Diego, CA 92101; Phone Number: (619) 533-4110

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: Sec. 15301 (d) for existing facilities, and Sec. 15302 (c) for replacement or reconstruction
- () Statutory Exemption

Reasons why project is exempt: The City of San Diego conducted an environmental review which determined that the project meets the categorical exemption criteria set forth in CEQA State Guidelines, Sections 15301 (d) and 15302 (c); and where the exceptions listed in Section 15300.2 would not apply.

Lead Agency Contact Person: Gretchen Eichar

Telephone: (619) 533-4110

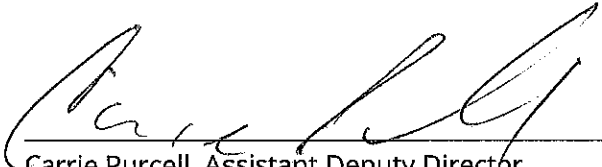
If filed by applicant:

1. Attach certified document of exemption finding.

Revised May 2016

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



Carrie Purcell, Assistant Deputy Director

10/27/17

Date

Check One:

(X) Signed By Lead Agency

() Signed by Applicant

Date Received for Filing with County Clerk or OPR:

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 1 OF 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.)

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- 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.

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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.

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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.

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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

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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

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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

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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.

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 9 OF 10	EFFECTIVE DATE October 15, 2002
	SUPERSEDES DI 55.27	DATED April 21, 2000

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. These 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.

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER DI 55.27	DEPARTMENT Water Department
SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)	PAGE 10 OF 10	EFFECTIVE DATE October 15, 2002
	SUPERSEDES DI 55.27	DATED April 21, 2000

- 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).

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



Application for Fire Hydrant Meter (EXHIBIT A)

(For Office Use Only)

NS REQ	FAC#
DATE	BY

METER SHOP (619) 527-7449

Meter Information

Application Date	Requested Install Date:
------------------	-------------------------

Fire Hydrant Location: (Attach Detailed Map//Thomas Bros. Map Location or Construction drawing.) <u>Zip:</u>	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: <input type="text"/>	<input type="checkbox"/>	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: <small>(PERSON IN ACCOUNTS PAYABLE)</small>			Phone: ()
Site Contact Name and Title:			Phone: ()
Responsible Party Name:			Title:
Cal ID#			Phone: ()
Signature:		Date:	
<small>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</small>			

Fire Hydrant Meter Removal Request	Requested Removal Date:
Provide Current Meter Location if Different from Above:	
Signature:	Title: Date:
Phone: ()	Pager: ()

<input type="checkbox"/> City Meter	<input type="checkbox"/> 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 WITH SPEND CURVE

City of San Diego, CM&FS Div., 9753 Chesapeake Drive, SD CA 92123

Project Name:

Work Order No or Job Order No.

City Purchase Order No.

Resident Engineer (RE):

RE Phone#: Fax#:

Contractor's Name:

Contractor's Address:

Contractor's Phone #:

Contractor's fax #:

Contact Name:

Invoice No.

Invoice Date:

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%	\$ -
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%	\$ -
					\$ -		\$ -		\$ -	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: _____

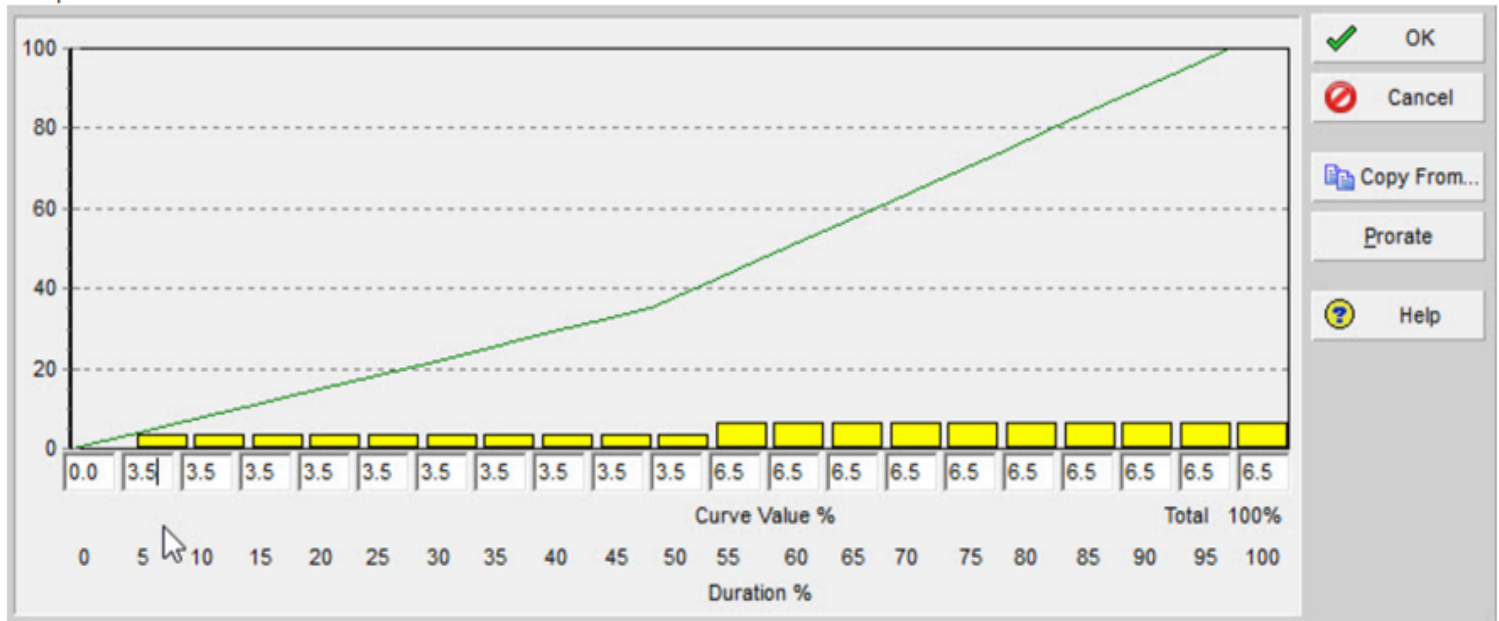
Sample Project Spend Curve

Sample Date Entries Required

Incremental Curve Value
Duration % Increment

0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%

Sample Screenshot from Primavera P6



APPENDIX E
ADJACENT PROJECTS

PREDESIGN LOCATION MAP

LA JOLLA SCENIC DRIVE PIPELINE



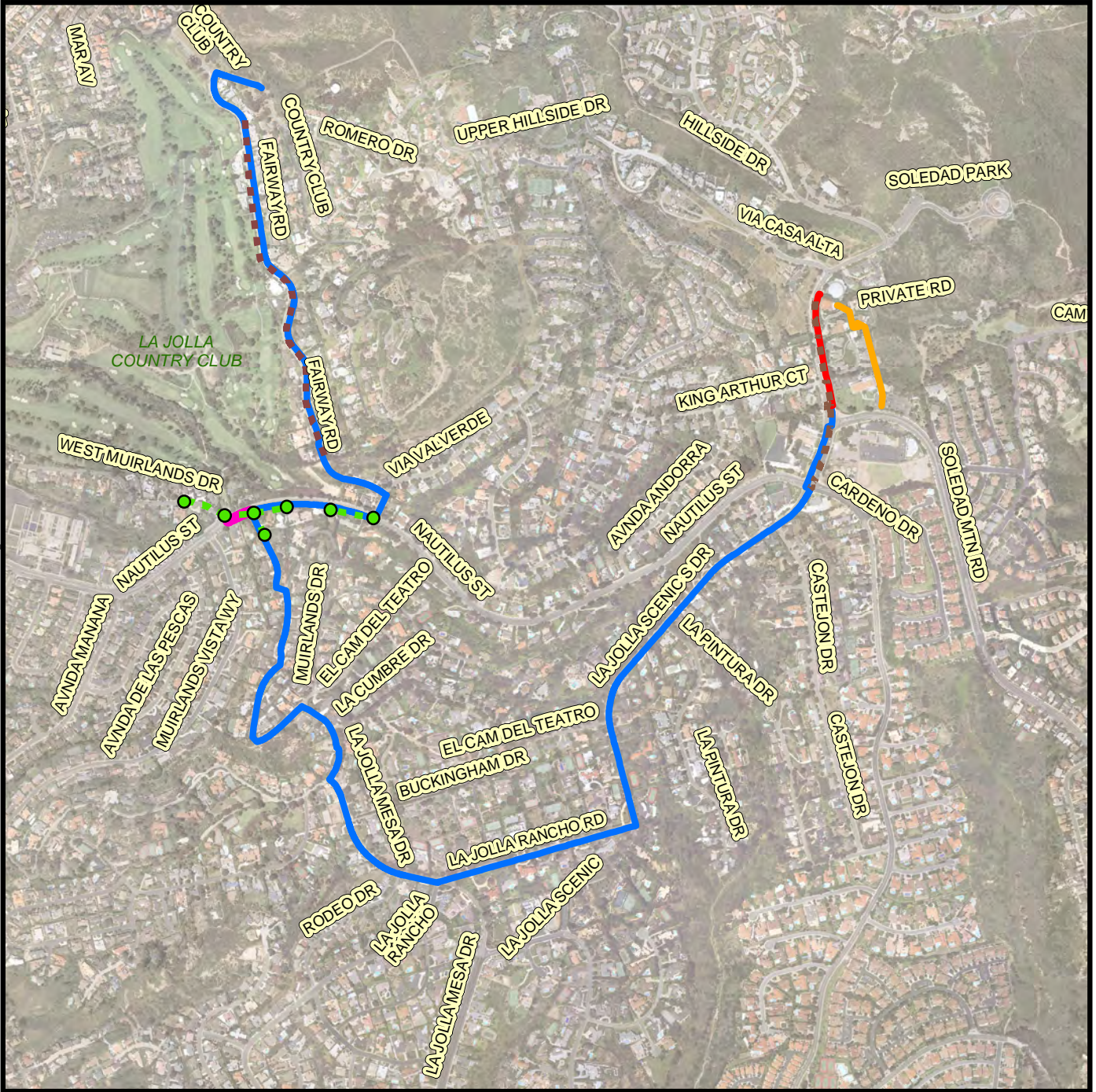
PROJECT IMPLEMENTATION DIVISION

PREDESIGN SENIOR ENGINEER
ALEX GARCIA
(619) 533-3634

PREDESIGN PROJECT MANAGER
CRAIG HOENES
(619) 533-3783

PREDESIGN PROJECT ENGINEER
CRAIG HOENES
(619) 533-3783

PREDESIGN DRAFTER
STEVE BLANTZ
(619) 533-3486



Legend

- Install New 16 Inch PVC Water
- Remove and Replace with 16 Inch PVC Water
- Remove and Replace with PVC Water (Same Diameter)
- Remove and Replace with 12 Inch PVC Water
- Water Main to be Abandoned
- - - Sewer Mains to be Replaced
- Sewer Manholes to be Replaced



File Path: S:\PITS\PITS-CIP-Preliminary-Engineering-and-Program-Coordination\Drafting\Water & Sewer Projects\Water Projects\La Jolla Scenic Drive Pipeline\CIP Tracking\Location Maps

Community Name: La Jolla

Council District: 1

SAP ID# S12009

Date: 3-17-2015
Soledad Pump Station Upgrades
Appendix E - Location Map



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Location Map La Jolla Country Club Reservoir & Pump Station

Senior Engineer
Hossein Azar
619-533-4102

PROJECT MANAGER
David Manela
619-533-6682



La Jolla Country Club
Reservoir

La Jolla Country Club
Water Pump Station

Legend

 Project Locations



COMMUNITY NAME: La Jolla

COUNCIL DISTRICT: 01

SAP ID: B-11024



APPENDIX F
SAMPLE OF PUBLIC NOTICE



CONSTRUCTION NOTICE

PROJECT TITLE

Work on your street will begin within one week to replace the existing water mains servicing your community.

The work will consist of:

- Saw-cutting and trench work on Ingulf Street from Morena Boulevard to Galveston Street to install new water mains, water laterals and fire hydrants.
• Streets where trenching takes place will be resurfaced and curb ramps will be upgraded to facilitate access for persons with disabilities where required.
• This work is anticipated to be complete in your community by December 2016.

How your neighborhood may be impacted:

- Water service to some properties during construction will be provided by a two-inch highline pipe that will run along the curb. To report a highline leak call 619-515-3525.
• Temporary water service disruptions are planned. If planned disruptions impact your property, you will receive advance notice.
• Parking restrictions will exist because of the presence of construction equipment and materials.
• "No Parking" signs will be displayed 72 hours in advance of the work.
• Cars parked in violation of signs will be TOWED.

Hours and Days of Operation:

Monday through Friday X:XX AM to X:XX PM.

City of San Diego Contractor:

Company Name, XXX-XXX-XXXX



CONSTRUCTION NOTICE

PROJECT TITLE

Work on your street will begin within one week to replace the existing water mains servicing your community.

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• Parking restrictions will exist because of the presence of construction equipment and materials.
• "No Parking" signs will be displayed 72 hours in advance of the work.
• Cars parked in violation of signs will be TOWED.

Hours and Days of Operation:

Monday through Friday X:XX AM to X:XX PM.

City of San Diego Contractor:

Company Name, XXX-XXX-XXXX

To contact the City of San Diego: SD Public Works 619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

To contact the City of San Diego: SD Public Works 619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

APPENDIX G

ADVANCED METERING INFRASTRUCTURE (AMI) DEVICE PROTECTION

Protecting AMI Devices in Meter Boxes and on Street Lights

The Public Utilities Department (PUD) has begun the installation of the Advanced Metering Infrastructure (AMI) technology as a new tool to enhance water meter reading accuracy and efficiency, customer service and billing, and to be used by individual accounts to better manage the efficient use of water. **All AMI devices shall be protected per Section 5-2, "Protection", of the 2015 Whitebook.**

AMI technology allows water meters to be read electronically rather than through direct visual inspection by PUD field staff. This will assist PUD staff and customers in managing unusual consumption patterns which could indicate leaks or meter tampering on a customer's property.

Three of the main components of an AMI system are the:

- A. Endpoints, see Photo 1:

Photo 1



B. AMI Antenna attached to Endpoint (antenna not always required), see Photo 2:

Photo 2



Network Devices, see Photo 3:

Photo 3



AMI endpoints transmit meter information to the AMI system and will soon be on the vast majority of meters in San Diego. These AMI devices provide interval consumption data to the PUD's Customer Support Division. If these devices are damaged or communication is interrupted, this Division will be alerted of the situation. The endpoints are installed in water meter boxes, coffins, and vaults adjacent to the meter. A separate flat round antenna may also be installed through the meter box lid. This antenna is connected to the endpoint via cable. The following proper installation shall be implemented when removing the lid to avoid damaging the antenna, cable, and/or endpoint. Photo 4 below demonstrates a diagram of the connection:

Photo 4



The AMI device ERT/Endpoint/Transmitter shall be positioned and installed as discussed in this Appendix. If the ERT/Endpoint/Transmitter is disturbed, it shall be re-installed and returned to its original installation with the end points pointed upwards as shown below in Photo 5.

The PUD's code compliance staff will issue citations and invoices to you for any damaged AMI devices that are not re-installed as discussed in the Contract Document

Photo 5 below shows a typical installation of an AMI endpoint on a water meter.

Photo 5

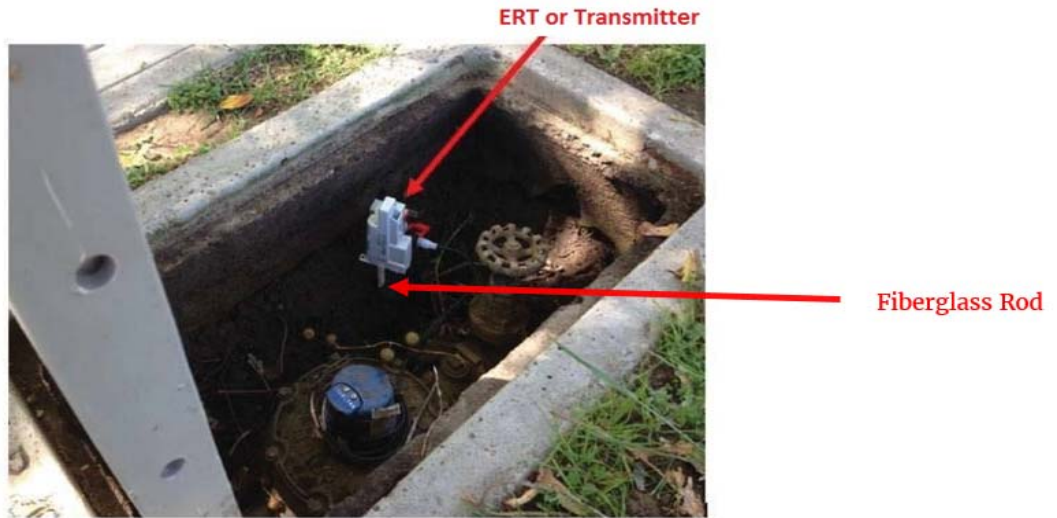


Photo 6 below is an example of disturbance that shall be avoided:

Photo 6



You are responsible when working in and around meter boxes. If you encounter these endpoints, use proper care and do not disconnect them from the registers on top of the water meter. If the lid has an antenna drilled through, do not change or tamper with the lid and inform the Resident Engineer immediately about the location of that lid. Refer to Photo 7 below:

Photo 7



Another component of the AMI system are the Network Devices. The Network Devices are strategically placed units (mainly on street light poles) that collect interval meter reading data from multiple meters for transmission to the Department Control Computer. **If you come across any of these devices on street lights that will be removed or replaced (refer to Photos 8 and 9 below), notify AMI Project Manager Arwa Sayed at (619) 362-0121 immediately.**

Photo 8 shows an installed network device on a street light. On the back of each Network Device is a sticker with contact information. See Photo 9. **Call PUD Water Emergency Repairs at 619-515-3525 if your work will impact these street lights.** These are assets that belong to the City of San Diego and you shall be responsible for any costs of disruption of this network.

Photo 8



Network Device

Photo 9



If you encounter any bad installations, disconnected/broken/buried endpoints, or inadvertently damage any AMI devices or cables, notify the Resident Engineer immediately. The Resident Engineer will then immediately contact the AMI Project Manager, Arwa Sayed, at (619) 362-0121.

APPENDIX H

MONTHLY DRINKING WATER DISCHARGE MONITORING FORM

MONTHLY DRINKING WATER DISCHARGE MONITORING FORM

All discharge activities related to this project comply with the State Water Resources Control Board ORDER WQ 2014-0194-DWQ, STATEWIDE GENERAL NPDES PERMIT FOR DRINKING WATER SYSTEMS DISCHARGES as referenced by (http://www.waterboards.ca.gov/water_issues/programs/npdes/docs/drinkingwater/final_statewide_wqo2014_0194_dwq.pdf), and as follows:

Project Name:		WBS or IO No.:		Contract No.:										
QSP Conducting Tests:				*Signature of QSP:										
BMPs MUST BE IN PLACE PRIOR TO ANY SCHEDULED DISCHARGE				*By signing, I certify that all of the statements and conditions for drinking water discharge events are correct.										
Event #	Discharge Location ¹	Discharge Description ²	Category ³	Sampling ⁴				Limit	Exceedance?		Notes			
				Measurement	Unit	Time	Result		No	Yes				
1	<p>Location</p> <p><u>Start Date</u></p> <p><u>Start Time</u></p> <p><u>End Time</u></p> <p><u>End Date</u></p>	<input type="checkbox"/> Scheduled <input type="checkbox"/> Emergency	<input type="checkbox"/> Chlorinated ⁵ <input type="checkbox"/> > 1 acre-foot (325,850 gal) ⁵ <input type="checkbox"/> Chollas Creek ⁵ <input type="checkbox"/> Groundwater Well ⁵ <input type="checkbox"/> Other ⁵ _____	Volume (estimate)	gal	Diverted	<div style="border: 1px solid black; width: 100%; height: 100%; display: flex; align-items: center; justify-content: center;"> X </div>	0.1 mg/L =Exceedance			*report discharge exceedances to the RE immediately and complete attached Monitoring Exceedance Form			
					gal	To Sewer								
					gal	To Storm Drain								
					gal	Total								
				Chlorine (Minimum samples first 10, first 60, and last 10 minutes)	mg/L									
				Turbidity (Minimum samples first 10, first 60, and last 10 minutes)	NTU									
PH (Minimum samples first 10, first 60, and last 10 minutes)	Units													
Additional Samples (Chollas Creek Only)	mg/L	Total Hardness												
	mg/L	Copper												
	mg/L	Lead												
	mg/L	Zinc												

See Instructions on Sheet 2

Revised 3/8/2017

Receiving Water Monitoring

1) Go to the location where the discharge enters the receiving water.

- Accessible
 Unable to Determine
 No Safe Access

2) If accessible, take pictures and complete the visual monitoring table below. If unable to determine, notify the RE. If no safe access, stop here.

Visual Monitoring		
<u>Is the discharge into the receiving water...</u>		
...causing erosion	<input type="checkbox"/> Yes	<input type="checkbox"/> NO
...carrying floating or suspended matter	<input type="checkbox"/> Yes	<input type="checkbox"/> NO
...causing discoloration	<input type="checkbox"/> Yes	<input type="checkbox"/> NO
...causing and impact to the aquatic life present	<input type="checkbox"/> Yes	<input type="checkbox"/> NO
...observed with visible film	<input type="checkbox"/> Yes	<input type="checkbox"/> NO
...observed with an sheen or coating	<input type="checkbox"/> Yes	<input type="checkbox"/> NO
...causing potential nuisance conditions	<input type="checkbox"/> Yes	<input type="checkbox"/> NO

3) If all answers are no, stop here. If any answers are yes, take pictures, document and immediately notify the RE

Instructions

- 1) Summarize the location of the discharge by connection location. For example: Albatross St (4th Av to 5th Av). Include the start date and time and the end date and time
- 2) Please select either scheduled or emergency. Scheduled discharges are those that the City knows in advance, for example CIP group jobs. Emergency discharges are those un planned discharges that the City is unaware of until after the discharge has commenced. PWD will only report on emergencies associated with CIP projects.
- 3) Select chlorinated, >1 acre-foot, well development or rehabilitation, or other discharges. Chlorinated are discharges of water that is dosed with chlorine in order to adequately sanitize and disinfect drinking water system facilities. Discharges >1 acre-foot are large discharges that are greater than 325,850 gallons, are not chlorinated, or not from a groundwater well. Chollas Creek are discharge located in the Chollas HSA, No. 908.22 as designated on the plans. Groundwater wells are projects associated with wells including development and rehabilitation.
- 4) Sampling Requirements:

Category	Measure	Limit
Emergency	Volume, Estimate	N/A
Chlorinated	Volume, Estimate	N/A
	Chlorine, Field	0.10 mg/L
	Turbidity, Visual	20 NTU (surface water) or 225 NTU (ocean)
	Estimate	
>1 ac-ft (325,850 gal)	pH, Field	6.0 to 9.0
	Volume, estimate	N/A
	Chlorine, Field	0.10 mg/L
	Turbidity, Visual	20 NTU (surface water) or 225 NTU (ocean)
Additional for Chollas Creek	Estimate	
	pH, Field	6.0 to 9.0
	Total Hardness (Lab)	
	Copper (Lab)	
	Lead (Lab)	
	Zinc (Lab)	

Revised 3/8/2017

Use Additional Sheets as necessary

Submit completed form to Resident Engineer at end of month

APPENDIX I
GEOLOGICAL FAULT INVESTIGATION REPORT



February 22, 2017

Mr. Michael Pollard, P.E.
Senior Project Manager
PSOMAS
3111 Camino Del Rio North, Suite 702
San Diego, CA 92108

**Subject: EVALUATION OF LOCAL FAULTING
SOLEDAD PUMP STATION REPLACEMENT
6751 La Jolla Scenic Drive, La Jolla, California
AGE Project No. 160 GS-14-B**

Dear Mr. Pollard:

In accordance with your request, we have reviewed a Report of Limited Geologic Fault Investigation that was prepared by Geotechnical Exploration, Inc. (GEI, 1999) for the La Jolla Zenith Residential Development located at 6701 La Jolla Scenic Drive South. GEI's investigation was performed on the adjacent property to the south of the pump station site, and involved the excavation of a 35-foot long trench. A list of references which were reviewed is included in Attachment A.

GEI's fault trench was excavated to a maximum depth of 10 feet and reportedly encountered fill soils over highly weathered and fractured, firm to stiff, formational materials of the Eocene-age Ardath Shale. The fault was encountered in the eastern half of the trench and exposed a 1/8 inch-wide clay gouge between massive, well indurated siltstone to the east and highly weathered and fractured siltstone to the west. The fault has a strike of N20E and dips steeply (80 to 85 degrees) to the southeast. GEI stated that the fault appears to be minor and should not impact the development of the site. They further stated that no topsoils or Holocene deposits were present to evaluate the age of the fault or activity. A 5-foot primary structure setback was recommended due to the "potentially active" classification of the fault.

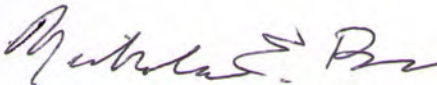
The projected fault trace traverses the southeast portion of the pump station site in the vicinity of the proposed improvements. The projected fault trace is approximately 10 feet east of AGE's boring B-1 which was performed in the asphalt paving surrounding the Soledad Reservoir. No shearing, fault gouge or other indications of faulting was observed in drive samples taken from this boring.

The fault is not shown on the published geologic maps (Kennedy & Tan, 2008 nor the City of San Diego's Seismic Safety Study, 2008). Furthermore, there is no evidence that this fault offsets geologic units that are younger than Eocene in age. Considering that the fault trends roughly perpendicular to the trend of the major active and potentially active Mount Soledad and Country Club faults, we suspect that the fault may actually represent a tectonic feature caused by uplift of Mount Soledad and may be classified as inactive. Consequently, it is our opinion that the fault does not pose a major seismic hazard to the proposed project.

We appreciate the opportunity to be of service on this project. If you have any questions regarding the contents of this letter or need further assistance, please feel free to contact our office.

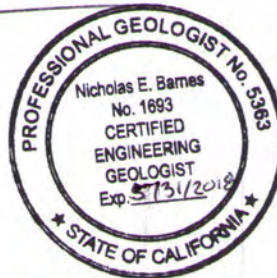
Sincerely,

ALLIED GEOTECHNICAL ENGINEERS, INC.



Nicholas E. Barnes, P.G./C.E.G.
Senior Geologist

NEB/SS/TJL:sem
Distr. (1 electronic copy) Addressee



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City of San Diego Seismic Safety Study, Geologic Hazards and Faults, Sheet No. 30, 2008 edition.

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Geotechnical Exploration, Inc., "Report of Limited Geologic Fault Investigation, La Jolla Zenith Residential Development, 6701 la Jolla Scenic Drive South, La Jolla, California", report dated March 12, 1999.



98-0540

REPORT OF LIMITED GEOLOGIC FAULT INVESTIGATION
La Jolla Zenith Residential Development
6701 La Jolla Scenic Drive South
La Jolla, California

JOB NO. 97-7198
12 March 1999

Prepared for:

Mr. Reza Paydar
c/o PAYDAR PROPERTIES




GEOTECHNICAL EXPLORATION, INC.

 SOIL & FOUNDATION ENGINEERING • GROUNDWATER
 HAZARDOUS MATERIALS MANAGEMENT • ENGINEERING GEOLOGY

12 March 1999

 Mr. Reza Paydar
 PAYDAR PROPERTIES
 7855 Herschel Avenue, Suite 201
 La Jolla, CA 92037

Job No. 97-7198

 Subject: Report of Limited Geologic Fault Investigation
 La Jolla Zenith Residential Development
 6701 La Jolla Scenic Drive South
 La Jolla, California

Dear Mr. Paydar:

In accordance with your request, *Geotechnical Exploration, Inc.* is providing this update "Report of Limited Geologic Fault Investigation" for the subject site. It is our understanding that the site is being developed to receive a four-lot residential development and associated improvements. We performed a preliminary soil investigation at the site and prepared a "Report of Preliminary Soil Investigation and Geologic Reconnaissance" dated March 12, 1998. This report of geologic fault investigation has been requested by the City of San Diego, due to a "potentially active" fault that was encountered on the adjacent property to the north and appears to trend in a southwest direction through the subject site. Our limited geologic fault investigation consisted of excavation of a 35-foot-long trench to evaluate the possible location of the mapped fault at the site.

I. SITE DESCRIPTION

The subject property is known as: Assessor's Parcel No. 352-310-41, in the City and County of San Diego, State of California.

7420 TRADE STREET • SAN DIEGO, CALIFORNIA 92121 • (619) 549-7222 • FAX: (619) 549-1604

La Jolla Zenith Residential Development
La Jolla, California

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The site, consisting of approximately 2.5 acres, is located at 6701 La Jolla Scenic Drive South, in the La Jolla area of the City of San Diego. The property is bordered on the north by a City of San Diego water tank and developed residential properties, on the south by an existing condominium complex, on the east by undeveloped land, and on the west by La Jolla Scenic Drive South.

Existing structures on the site at the time of our field investigations consisted of a split-level clubhouse building, several tennis courts, and an asphalt parking lot. Presently, vegetation on the site consists primarily of ornamental landscaping with trees and shrubs and iceplant groundcover on the slopes. A 16-inch-diameter water main crosses the site from the water tank on the adjacent property to the northwest down to the southeast.

The multi-level property slopes moderately to steeply down to the east from La Jolla Scenic Drive South. Elevations of the various tennis court pads range from 717 feet above mean sea level (MSL) to 670 feet MSL. Approximate elevations across the site range from a high of 728 feet above MSL at the northwest corner of the site, down to 600 feet MSL at the toe of the fill slope in the eastern portion of the site.

II. SOIL AND GENERAL GEOLOGIC DESCRIPTION

Our original investigation and review of pertinent geologic maps and reports indicate that the site is underlain by previously compacted fill soils, a limited amount of topsoils, and dense formational materials of the Eocene-age Ardath Shale.



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Artificial Fill (Qaf): Previously compacted fill soil was encountered on the surface of the eastern portion of the site. The fill ranges from 3 feet in the western parking lot, to approximately 30 feet in the eastern portion of the site. Deeper fill soils may exist in areas where deep removals were required during the mass grading. The fill is loose to medium dense in the upper 2 to 3 feet and appears to improve in quality below that depth. The fill consists of tan-gray and gray-brown, silty, fine to medium sand and fine sandy silt with some clay and cobbles. The fills are considered to have a low expansion potential. Some medium to highly expansive fill soils may exist in areas that were not investigated. The fill soils encountered in the exploratory fault trench ranged from 0 to 4 feet directly under the asphalt pavement and over the Ardath Shale Formation.

Topsoils: The topsoils encountered at the site consist of stiff, moist, red-brown, sandy clay with some roots and rock fragments. These materials range from 1 to 2 feet in thickness and were only encountered in B-4. These soils are considered to have a medium expansion potential. No topsoils were encountered in the exploratory fault trench.

Ardath Shale (Ta): Most of the site is mapped as being underlain beneath the previously existing terrace deposits by the Eocene-age Ardath Shale (Kennedy 1975). In our borings the Ardath Shale consists primarily of massive, tan-gray and orange, sandy siltstone and silty sandstone that is dense and well indurated. The Ardath Shale is considered to have a low to medium expansion potential.

The Ardath Shale exposed in the exploratory fault trench consisted of highly weathered and fractured siltstones and claystones to a depth of 3 to 4 feet, where they become more massive, but still blocky.



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III. GEOLOGIC HAZARDS

A. Faulting and Seismicity

The San Diego area is part of a seismically active region of California. It is on the eastern boundary of the Southern California Continental Borderland, part of the Peninsular Ranges Geomorphic Province. This region is part of a broad tectonic boundary between the North American and Pacific Plates. The actual plate boundary is characterized by a complex system of active, major, right-lateral strike-slip faults, trending northwest/southeast. This fault system extends eastward to the San Andreas Fault (approximately 70 miles from San Diego) and westward to the San Clemente Fault (approximately 50 miles from San Diego) (Berger and Schug, 1991).

During recent history, the San Diego County area has been relatively quiet seismically. No fault ruptures or major earthquakes have been experienced in historic time within the San Diego area. Since earthquakes have been recorded by instruments (since the 1930s), the San Diego area has experienced scattered seismic events with Richter magnitudes generally less than 4.0. During June 1985, a series of small earthquakes occurred beneath San Diego Bay; three of these earthquakes had recorded magnitudes of 4.0 to 4.2. In addition, the Oceanside earthquake of July 13, 1986, resulted in a magnitude of 5.3 (Hauksson, 1988) located approximately 26 miles offshore of the City of Oceanside.

In California, major earthquakes can generally be correlated with movement on active faults. As defined by the California Division of Mines and Geology (Hart, E.W., 1980), an "active" fault is one which has had ground surface displacement



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within Holocene time (about the last 11,000 years). Additionally, faults along which major historical earthquakes have occurred (about the last 210 years in California) are also considered to be active (Association of Engineering Geologist, 1973). The California Division of Mines and Geology defines a "potentially active" fault as one which has had ground surface displacement during Quaternary time, that is during the past 2 to 3 million years (Hart, E.W., 1980).

Evaluation of earthquake risk requires that the effect of faulting on and the mass stability of a site be evaluated utilizing the M_{10} seismic design event, i.e., an earthquake event on an active fault with less than a 10 percent probability of being exceeded in 50 years. Further, sites are classified into "site classes" A, B, C and D. Site classes are defined by their shear velocities where shear velocity is the speed at which shear waves move through the upper 30 meters (approximately 100 feet) of the ground. These are:

- A \Rightarrow Greater than 750 m/s (2461 ft/s)
- B \Rightarrow 360 m/s (1181 ft/s) to 750 m/s (2461 ft/s)
- C \Rightarrow 180 m/s (591 ft/s) to 360 m/s (1181 ft/s)
- D \Rightarrow Less than 180 m/s (591 ft/s)

By utilizing an earthquake magnitude M_{10} for a seismic event on an active fault, knowing the site class and ground type, a prediction of anticipated site ground acceleration, g , from these events can be estimated. The subject site has been assigned Classification "C".

An estimation of the peak ground acceleration and the repeatable high ground acceleration (RHGA) likely to occur at the project site by the known significant local



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and regional faults within 100 miles of the site is also included in Appendix A. Also, a listing of the known historic seismic events that have occurred within 100 miles of the site at a magnitude of 5.0 or greater since the year 1800, and the probability of exceeding the experienced ground accelerations in the future based upon the historical record, is provided in Appendix B. Both Appendix A and Appendix B are tables generated from computer programs EQFault and EQSearch by Thomas F. Blake (1989) utilizing a digitized file of late-Quaternary California faults (EQ Fault) and a file listing of recorded earthquakes (EQSearch). Estimations of site intensity are also provided in these listings as Modified Mercalli Index values. The Modified Mercalli Intensity Index is provided as Appendix C.

It is our opinion that a known "active" fault presents the greatest seismic risk to the subject site during the lifetime of the proposed residence. To date, the nearest known "active" faults to the subject site are the northwest-trending Rose Canyon Fault, Coronado Bank Fault and the Elsinore Fault.

Rose Canyon Fault: The Rose Canyon Fault Zone, located approximately ½-mile northeast of the subject site, is mapped trending north-south from La Jolla to downtown San Diego, from where it appears to head southward into San Diego Bay, through Coronado and offshore. The Rose Canyon Fault Zone is considered to be a complex zone of onshore and offshore, en echelon strike slip, oblique reverse, and oblique normal faults. The Rose Canyon Fault is considered to be capable of causing a 7.5-magnitude earthquake and considered microseismically active, although no significant recent earthquake is known to have occurred on the fault. Investigative work on faults (believed to be part of the Rose Canyon Fault Zone) at the Police Administration and Technical Center in downtown San Diego and at the SDG&E facility in Rose Canyon, has encountered offsets in Holocene (geologically



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recent) sediments. These findings have been accepted as confirmed Holocene displacement on the Rose Canyon Fault and this previously classified "potentially active" fault has now been upgraded to an "active" fault as of November 1991 (California Division of Mines and Geology -- Fault Rupture Hazard Zones in California, 1994).

As part of our limited geologic fault investigation, a 35-foot-long exploratory trench was excavated across a portion of the site in an east-west direction to evaluate the possible location of a minor fault that was encountered on the adjacent property to the north. The mapped fault appeared to trend in a southwest direction through the subject site (N20E; 80-85° SE). The fault trench was placed in the asphalt driveway along the south side of the existing parking lot where the fault was presumed to cross. No other access was available on the site due to the present use of tennis courts and the clubhouse area.

The trench was excavated to a maximum depth of 10 feet and exposed artificial fill soils over highly weathered and fractured, firm to stiff, formational materials of the Eocene-age Ardath Shale. The fault was encountered in the eastern half of the trench and exposed a 1/8-inch-wide clay gouge between massive, well indurated siltstone to the east and highly weathered and fractured siltstone to the west. Although the fault appears to be minor and should not impact the development of the site, no topsoils or Holocene deposits were present to evaluate its age or activity. We have recommended a 5 feet primary structure setback due to its "potentially active" classification (refer to Figure No. II, Exploratory Trench T-1). X

Coronado Bank Fault: The Coronado Bank Fault is located approximately 12 miles southwest of the site. Evidence for this fault is based upon geophysical data

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(acoustic profiles) and the general alignment of epicenters of recorded seismic activity (Greene, 1979). An earthquake of 5.3 magnitude, recorded July 13, 1986, is known to have been centered on the fault or within the Coronado Bank Fault Zone. Although this fault is considered active, due to the seismicity within the fault zone, it is significantly less active seismically than the Elsinore Fault (Hileman, 1973). It is postulated that the Coronado Bank Fault is capable of generating a 7.0-magnitude earthquake and is of great interest due to its close proximity to the greater San Diego metropolitan area.

Elsinore Fault: The Elsinore Fault is located approximately 40 miles northeast of the site. The Elsinore Fault extends approximately 200 km (125 miles) from the Mexican border to the northern end of the Santa Ana Mountains. The Elsinore Fault zone is a 1- to 4-mile-wide, northwest-southeast-trending zone of discontinuous and en echelon faults extending through portions of Orange, Riverside, San Diego, and Imperial Counties. Individual faults within the Elsinore Fault Zone range from less than 1 miles to 16 miles in length. The trend, length and geomorphic expression of the Elsinore Fault Zone identified it as being a part of the highly active San Andreas Fault system.

Like the other faults in the San Andreas system, the Elsinore Fault is a transverse fault showing predominantly right-lateral movement. According to Hart, et al. (1979), this movement averages less than 1 centimeter per year. Along most of its length, the Elsinore Fault Zone is marked by a bold topographic expression consisting of linearly aligned ridges, swales and hallows. Faulted Holocene alluvial deposits (believed to be less than 11,000 years old) found along several segments of the fault zone suggest that at least part of the zone is currently active.



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Although the Elsinore Fault Zone belongs to the San Andreas set of active, northwest-trending, right-slip faults in the southern California area (Crowell, 1962), it has not been the site of a major earthquake in historic time, other than a 6.0-magnitude quake near the town of Elsinore in 1910 (Richter, 1958; Topozada and Parke, 1982). However, based on length and evidence of late-Pleistocene or Holocene displacement, Greensfelder (1974) has estimated that the Elsinore Fault Zone is reasonably capable of generating an earthquake with a magnitude as large as 7.5. Recent study and logging of exposures in trenches in Glen Ivy Marsh across the Glen Ivy North Fault (a strand of the Elsinore Fault Zone between Corona and Lake Elsinore), suggest a maximum earthquake recurrence interval of 300 years, and when combined with previous estimates of the long-term horizontal slip rate of 0.8 to 7.0 mm/year, suggest typical earthquake magnitudes of 6 to 7 (Rockwell, 1985).

B. Other Geologic Hazards

Ground Rupture: Ground rupture is characterized by bedrock slippage along an established fault and may result in displacement of the ground surface. For ground rupture to occur along a fault, an earthquake usually exceeds magnitude 5.0. If a 5.0-magnitude earthquake were to take place on a local fault, an estimated surface-rupture length 1 mile long could be expected (Greensfelder, 1974). The minor fault encountered at the site during our investigation is likely related to the tectonic uplift and/or folding of the Mount Soledad Block. No topsoil or Holocene-age deposits were observed in the trench exposure. As such, the activity of the fault is unknown, although it can be classified as "potentially active." The risk of ground rupture appears to be minor.



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Ground Shaking: Structural damage caused by seismically induced ground shaking is a detrimental effect directly related to faulting and earthquake activity. Ground shaking is considered to be the greatest seismic hazard in San Diego County. The intensity of ground shaking is dependent on the magnitude of the earthquake, the distance from the earthquake, and local seismic condition. Earthquakes of magnitude 5.0 Richter scale or greater are generally associated with significant damage. It is our opinion that the most serious damage to the site would be caused by a large earthquake originating on a nearby strand of the Rose Canyon Fault Zone. Although the chance of such an event is remote, it could occur within the useful life of the structure. The anticipated ground accelerations at the site from earthquakes on faults within 100 miles of the site are provided in Tables 1 and 2, Appendix A.

Landslides: According to our geologic reconnaissance and a review of the geologic maps (Kennedy, 1975) and aerial photographs (4-11-53, AXN-8M-1 and 2), there are no known or suspected ancient landslides located on the site. However, based on a review of the City of San Diego, Seismic Safety Study for faults and geologic hazards, the site is located within a low to moderate risk geologic hazard area designated as "Zones 25 and 26" due to potential unfavorable geologic structures within the underlying formational materials.

Liquefaction: The liquefaction of saturated sands during earthquakes can be a major cause of damage to buildings. Liquefaction is the process in which soils are transformed into a dense fluid which will flow as a liquid when unconfined. It occurs principally in loose, saturated sands and silts when they are shaken by an earthquake.



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On this site, the risk of liquefaction of foundation material due to seismic shaking is considered to be remote due to the relatively high density of the compacted fill and natural-ground material and the lack of a shallow water table under the site.

Summary: It is our opinion that no significant geologic hazards exist at the subject site. We have recommended a minimum 5 feet primary structure setback from the minor, "potentially active" fault that crosses the site.

The owner should understand that there is some risk associated with any construction in the La Jolla area due to the common existence of deep-seated ancient landsliding and the proximity of the Rose Canyon Fault, which is considered "active." A structural engineer should be asked to review the ground acceleration possible at the site from the Rose Canyon Fault (see Table 2 - Appendix A). The maximum probable repeatable ground acceleration anticipated is 0.329g). Based upon the owner's level of risk acceptance and cost concerns, the structural engineer can provide a number of structural alternatives to help improve the stability of the structure against seismic-related damage.

IV. LIMITATIONS

Our conclusions and recommendations have been based on all available data obtained from our field investigation and laboratory analysis, as well as our experience with the soils and formational materials located in the La Jolla area of



La Jolla Zenith Residential Development
La Jolla, California

Job No. 97-7198

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the City of San Diego. Of necessity, we must assume a certain degree of continuity between exploratory excavations and/or natural exposures. It is, therefore, necessary that all observations, conclusions, and recommendations be verified at the time grading operations begin or when footing excavations are placed. In the event discrepancies are noted, additional recommendations may be issued, if required.

The work performed and recommendations presented herein are the result of an investigation and analysis which meet the contemporary standard of care in our profession within the County of San Diego. No warranty is provided.

This report should be considered valid for a period of two (2) years, and is subject to review by our firm following that time. If significant modifications are made to the building plans, especially with respect to the height and location of any proposed structures, this report must be presented to us for immediate review and possible revision.

The firm of *Geotechnical Exploration, Inc.* shall not be held responsible for changes to the physical condition of the property, such as addition of fill soils or changing drainage patterns, which occur subsequent to issuance of this report and the changes are made without our observations, testing, and approval.




La Jolla Zenith Residential Development
La Jolla, California

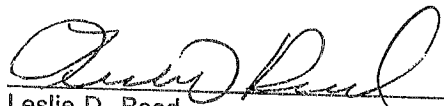
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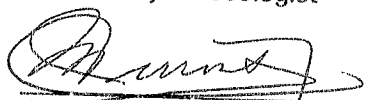
Once again, should any questions arise concerning this report, please feel free to contact the Project Coordinator. Reference to our Job No. 97-7198 will expedite a reply to your inquiries.

Respectfully submitted,

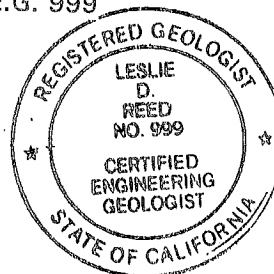
GEOTECHNICAL EXPLORATION, INC.


Jay K. Heiser
Senior Project Geologist


Leslie D. Reed
President/C.E.G. 999


Jaime A. Cerros, P.E.
R.C.E. 34422/G.E. 2007
Senior Geotechnical Engineer

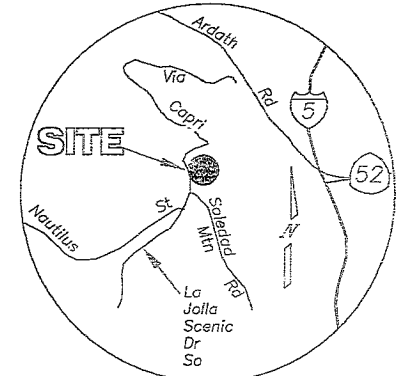
JKH/LDR/JAC/pj



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SCALE: 1" = 50'

VICINITY MAP

REFERENCE: This Plot Plan was prepared from an existing drawing prepared by E RICCI, CIVIL ENGINEERING and from on-site field reconnaissance performed by GEI.

NOTE: This Plot Plan is not to be used for legal purposes. Locations and dimensions are approximate. Actual property dimensions and locations of utilities may be obtained from the Approved Building Plans or the "As-Built" Grading Plans.

LEGEND

- ASSUMED PROPERTY BOUNDARY
- PROPOSED STRUCTURE
- APPROXIMATE LOCATION OF EXPLORATORY TRENCH
- FAULT LOCATION
- PROPOSED TOPOGRAPHY (Feet)
- LOFFEL STEIN BLOCK WALL

PLOT PLAN

LA JOLLA ZENITH
 6701 LA JOLLA SCENIC DRIVE SOUTH
 LA JOLLA, CA
 FIGURE NUMBER 1
 JOB NUMBER 97-7198



GEOTECHNICAL
 EXPLORATION INC.

MARCH 1998

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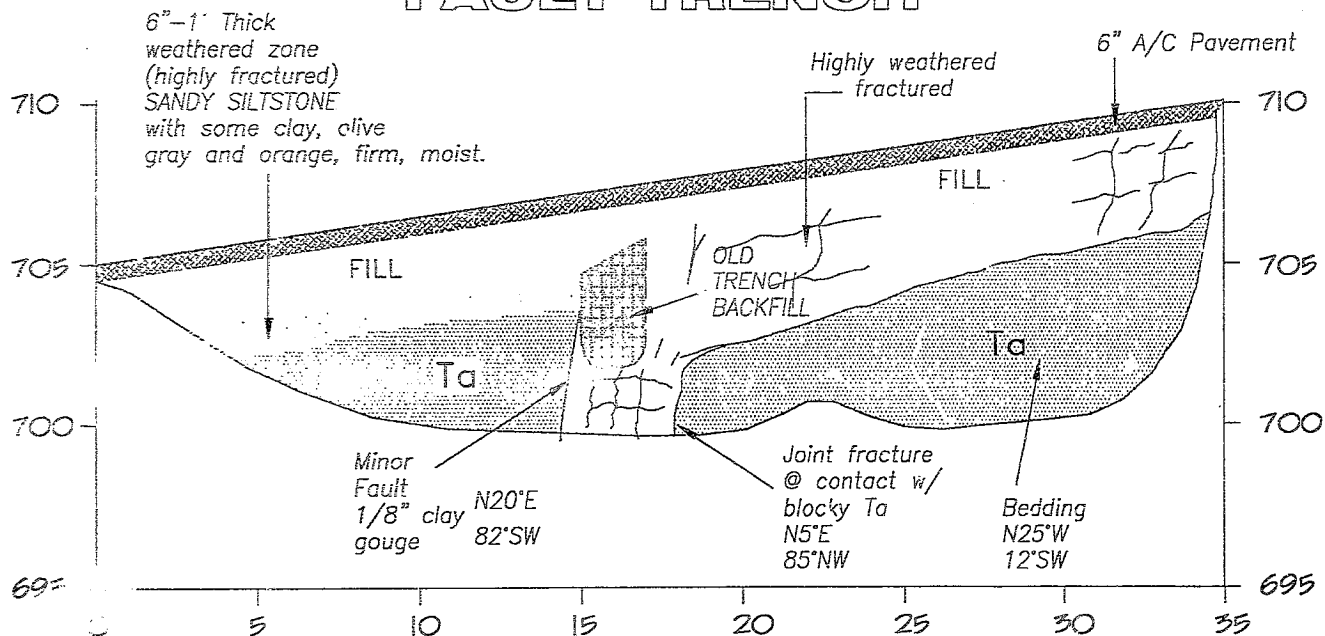
LA JOLLA ZENITH

T-1

FAULT TRENCH

E

W



Lower Ta on east side of fault massive with distinct weathered profile, little evidence of bedding becomes less fractured with depth very blocky siltstone lt-olive gray & tan-orange.
 Bedding N-S
 15°SE
 N25°E
 12°SE

Bedding
 N20°W
 8°SW

Upper Ta on west side of fault is highly weathered and fractured top a depth of 3'-4'. Becomes more massive but very blocky, still at depth.

SCALE: 1" = 5'
 (horizontal & vertical)

LA JOLLA ZENITH
 8701 LA JOLLA SCENIC DRIVE SOUTH
 LA JOLLA, CA.
 FIGURE NUMBER II
 JOB NUMBER 97-7198



MARCH 1999

T198-II

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MARCH 1998

PROPOSED RESIDENTIAL DEVELOPMENT
6701 LA JOLLA SCENIC DR SO.
LA JOLLA, CA.

GEOLOGY MAP
(1975)

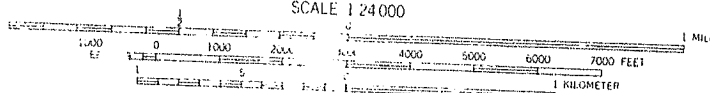
FIGURE NUMBER 1b
JOB NUMBER 97-7198



GEOLOGY OF THE LA JOLLA QUADRANGLE SAN DIEGO COUNTY, CALIFORNIA

by Michael P. Kennedy

SCALE 1:24000



CONTOUR INTERVAL 20 FEET
 DOTTED LINES REPRESENT 10 FOOT CONTOURS
 DATUM IS MEAN SEA LEVEL
 DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER
 SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
 THE MEAN RATTLE OF TIDE IS APPROXIMATELY 4 FEET

1975

EXPLANATION

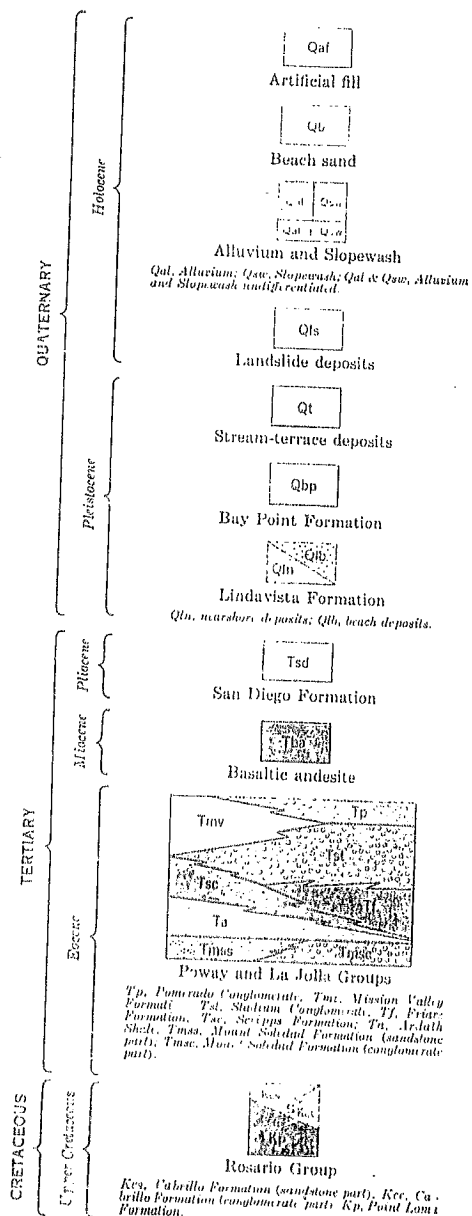


FIGURE NUMBER 1c
 JCB NUMBER 97-7198



EQUIPMENT Portable Auger Drill Rig	DIMENSION & TYPE OF EXCAVATION 6" diameter boring	DATE LOGGED 12-29-97
SURFACE ELEVATION ± 680' Mean Sea Level	GROUNDWATER DEPTH Not encountered	LOGGED BY JKH

DEPTH FT.	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION		U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + (%) CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
			DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)										
5			SILTY FINE TO MEDIUM SAND with slight clay binder, some pebbles and cobbles (to 4" diameter). Loose to medium dense. Damp. Tan-brown. - cobbles		SM/SC	7.3	115.0	8.5	132	87		39	3"
			FILL			17.8	107.6	13.0	121	89			
10			FINE SANDY SILT with some clay and chunks of siltstone and sandstone. Firm to stiff (medium dense). Damp. Tan-gray and orange. - same, becomes damp to moist		ML/MC							37	3"
						22.5	99.3					23	2"
												33	3"
15			FINE SANDY SILT with some clay, roots and cobbles, chunks of siltstone. Stiff (dense). Damp to moist. Tan-gray and dark brown.		ML/MC	17.0	108.5			90		50+	3"
			FILL									36	2"
20			SILTY FINE SAND/SANDY SILT. Firm. Moist. Tan-gray and orange.		SM/ML							25	2"
			FORMATION									38	2"
25			Bottom of hole @ 22'										







<ul style="list-style-type: none"> ▽ WATER TABLE ⊗ LOOSE BAG SAMPLE ① IN-PLACE SAMPLE ■ DRIVE SAMPLE Ⓢ SAND CONE/F.D.T. ▨ CONTINUOUS CORE SAMPLE 	JOB NAME Proposed Residential Development	
	JOB LOCATION 6701 La Jolla Scenic Drive South, La Jolla, California	
	JOB NUMBER 97-7198	REVIEWED BY
	FIGURE NUMBER 11a	LOG No. B-1

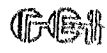


EQUIPMENT Portable Auger Drill Rig	DIMENSION & TYPE OF EXCAVATION 6" diameter boring	DATE LOGGED 12-29-97
SURFACE ELEVATION ± 682' Mean Sea Level	GROUNDWATER DEPTH Perched @ 7'-8'	LOGGED BY JKH

DEPTH FT.	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION		U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + (% CONSOL. -)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
			DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)										
5			SILTY FINE TO MEDIUM SAND with slight clay binder and some pebbles and cobbles. Loose to medium dense. Damp to moist. Tan-gray and orange-brown.		SM/SC	14.2	112.2	8.5	132	85	*20	22	3"
5			SILTY FINE TO MEDIUM SAND with clay roots and some rock fragments. Medium dense. Moist to wet. Dark gray-brown.		SC	13.5	116.2			88		35	3"
10			FILL									21	2"
10			FINE SANDY SILT with some clay and chunks of siltstone and sandstone. Firm to stiff (medium dense). Moist. Tan-gray and orange.		ML/MC	22.8	102.4	13.0	121	85		37	3"
15			CLAYEY SILT with some sand and chunks of siltstone and sandstone. Stiff. Moist. Tan-gray and orange brown.			21.4	104.7			87		40	3"
15			FILL									30+	2"
20			Refusal @ 18' on rock										







* U3C EXPANSION INDEX


-  WATER TABLE
-  LOOSE BAG SAMPLE
-  IN-PLACE SAMPLE
-  DRIVE SAMPLE
-  SAND CONE/F.D.T.
-  CONTINUOUS CORE SAMPLE

JOB NAME Proposed Residential Development	
SITE LOCATION 6701 La Jolla Scenic Drive South, La Jolla, California	
JOB NUMBER 97-7198	REVIEWED BY 
FIGURE NUMBER 11b	LOG No. B-2

EQUIPMENT Portable Auger Drill Rig	DIMENSION & TYPE OF EXCAVATION 6" diameter boring	DATE LOGGED 12-29-97
SURFACE ELEVATION ± 710' Mean Sea Level	GROUNDWATER DEPTH Not encountered	LOGGED BY JKH

DEPTH FT.	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION		U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + (%) CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
			DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)										
			2"-3" Asphalt surface										
5			SILTY FINE TO MEDIUM SAND with clay and some rock fragments. Loose (stiff). Moist. Tan-gray and brown.	FILL	SM/SC	24.8	97.8	13.0	121	80		24	3"
10			FINE SANDY SILT, poorly to moderately indurated. Firm to stiff. Damp. Tan-gray and orange.	FORMATION	ML								
			Bottom of hole @ 6'										

-  WATER TABLE
-  LOOSE BAG SAMPLE
-  IN-PLACE SAMPLE
-  DRIVE SAMPLE
-  SAND CONE/F.D.T.
-  CONTINUOUS CORE SAMPLE

JOB NAME Proposed Residential Development		
SITE LOCATION 6701 La Jolla Scenic Drive South, La Jolla, California		
JOB NUMBER 97-7198	REVIEWED BY	LOG No.
FIGURE NUMBER 11c		B-3

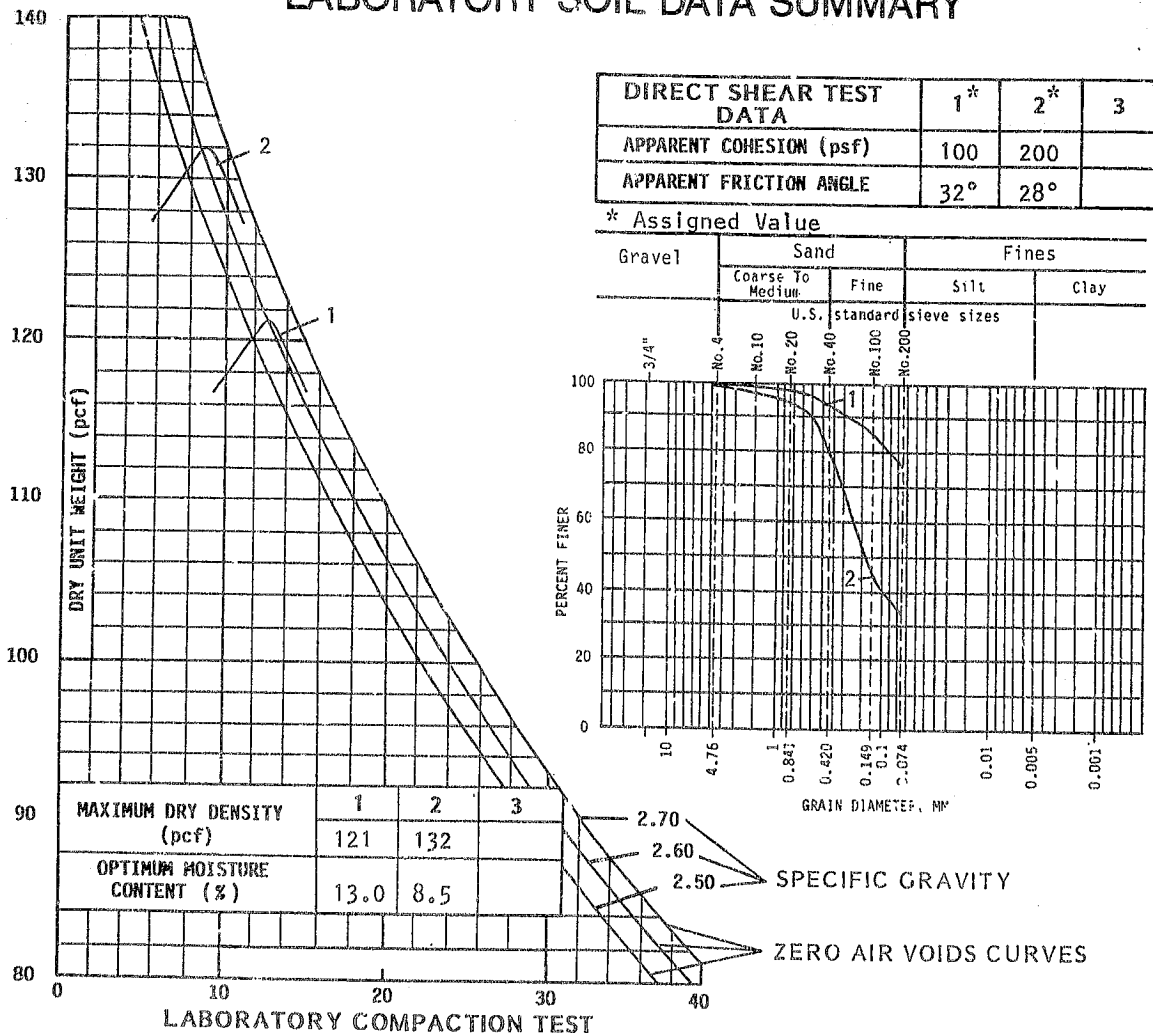
EQUIPMENT Portable Auger Drill Rig		DIMENSION & TYPE OF EXCAVATION 6" diameter boring	DATE LOGGED 1-5-98
SURFACE ELEVATION ± (70) Mean Sea Level		GROUNDWATER DEPTH Not encountered	LOGGED BY DV

DEPTH FT.	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION		U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + (%) CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
			DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)										
5			SILTY FINE SAND. Loose to medium dense. Damp. Tan-light brown. Intact roots to 1/2".		SM							50+	3"
			- refusal on rock/hard layer 3 3/4' Moved boring 2' west. Added H2O to hole to pull our 2'± of slough.									50+	3"
			FILL										
			Bottom/refusal @ 50'										
10			Very stiff reddish-brwn clay in sample tip/Topsoil-Slopewash.										

- WATER TABLE
- LOOSE BAG SAMPLE
- IN-PLACE SAMPLE
- DRIVE SAMPLE
- SAND CONE/F.D.T.
- CONTINUOUS CORE SAMPLE

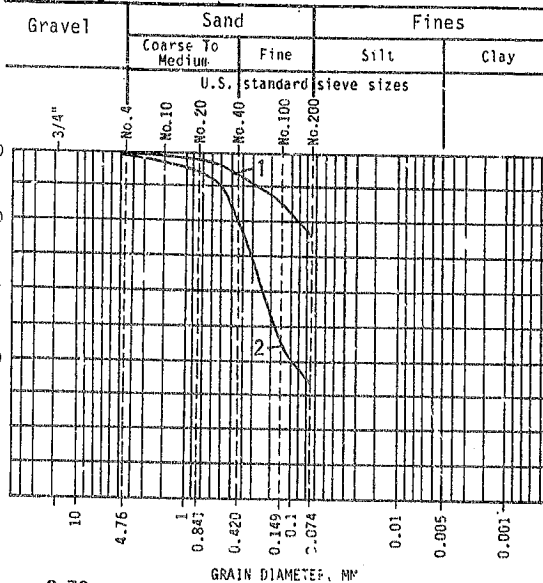
JOB NAME Proposed Residential Development	
SITE LOCATION 6701 La Jolla Scenic Drive South, La Jolla, California	
JOB NUMBER 97-7198	REVIEWED BY
FIGURE NUMBER 11d	LOG No. B-4

LABORATORY SOIL DATA SUMMARY



DIRECT SHEAR TEST DATA	1*	2*	3
APPARENT COHESION (psf)	100	200	
APPARENT FRICTION ANGLE	32°	28°	

* Assigned Value



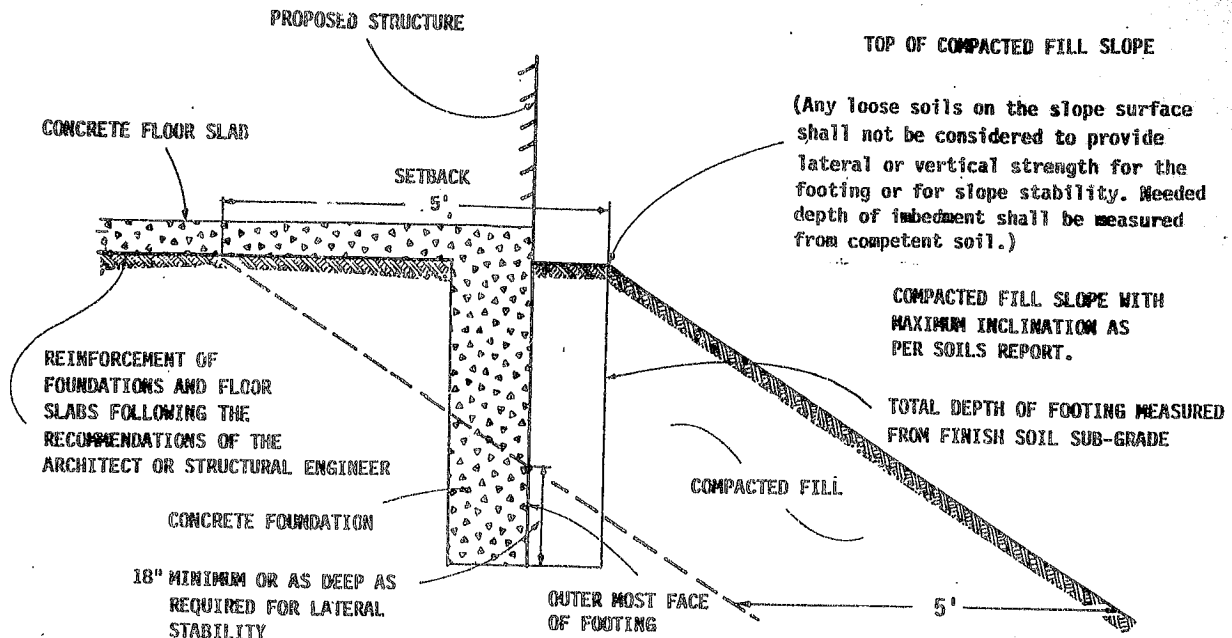
SOIL TYPE	SOIL CLASSIFICATION	BORING No.	TRENCH No.	DEPTH
1	FINE SANDY SILT with some clay. Tan-gray and orange.	B-1		5-10'
2	SILTY FINE TO MEDIUM SAND with slight clay. Tan-gray and orange-brown.	B-2		5'
3				

SWELL TEST DATA	1	2	3
INITIAL DRY DENSITY (pcf)	-	116.7	
INITIAL WATER CONTENT (%)	-	7.8	
LOAD (psf)	-	144	
UBC EXPANSION INDEX	≤50	20	

FIGURE NUMBER III
JOB NUMBER 97-7198



FOUNDATION REQUIREMENTS NEAR SLOPES



TYPICAL SECTION

(SHOWING PROPOSED FOUNDATION LOCATED WITHIN 5 FEET OF TOP OF SLOPE)

18" FOOTING / 5' SETBACK

TOTAL DEPTH OF FOOTING

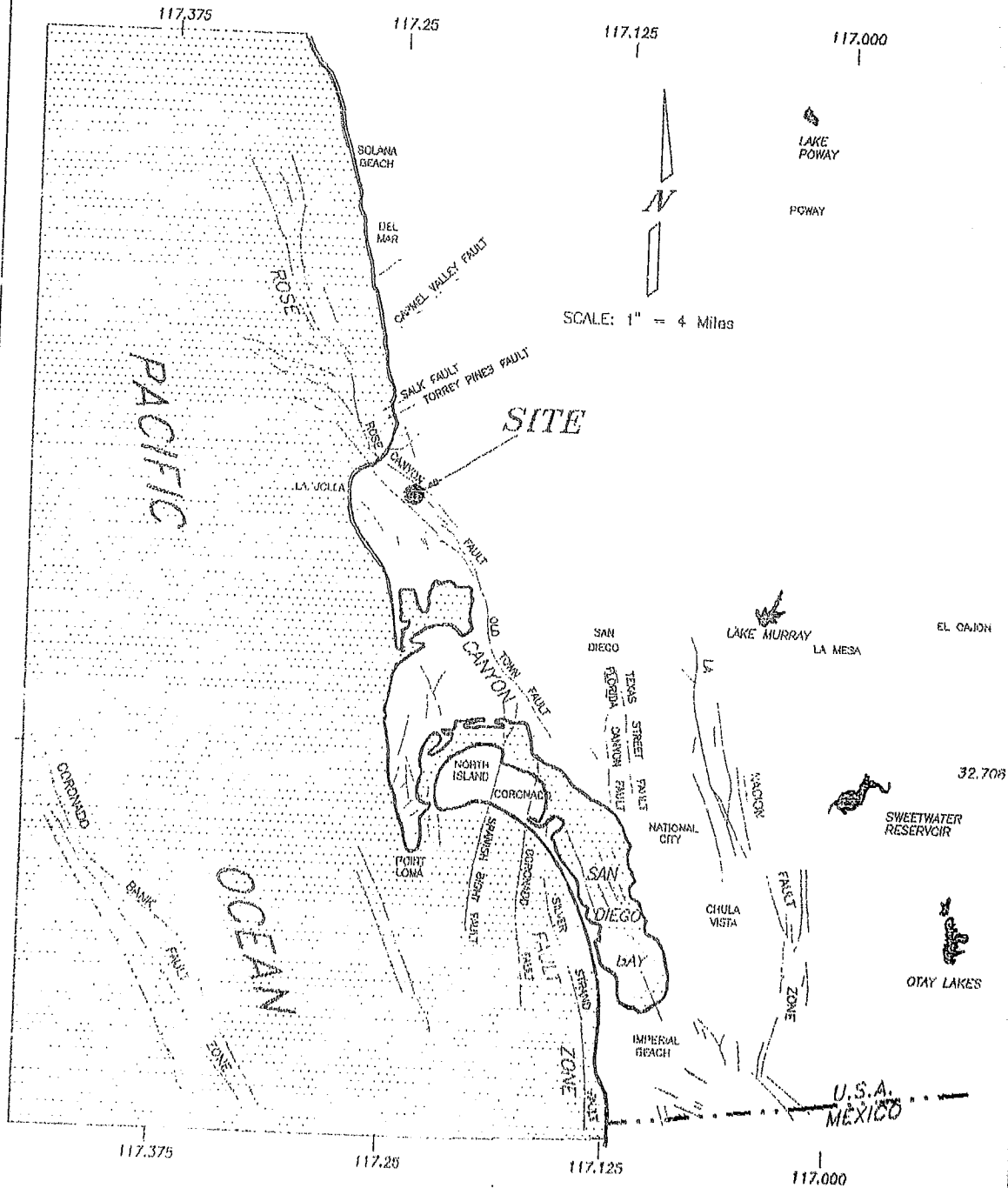
DISTANCE FROM TOP OF SLOPE	TOTAL DEPTH OF FOOTING	
	1.5:1.0 SLOPE #	2.0:1.0 SLOPE
0	58"	48"
1'	51"	42"
2'	42"	36"
3'	34"	30"
4'	26"	24"
5'	18"	18"

when applicable

FIGURE NUMBER IV
JOB NUMBER 97-7198



LOCAL FAULT MAP



COMPILED FROM G.D.M.G. MAP-5

STAN-3

FIGURE NUMBER V
JOB NUMBER 97-7198



APPENDIX A UNIFIED SOIL CLASSIFICATION CHART

SOIL DESCRIPTION

COARSE-GRAINED

More than half of material is larger than a No. 200 sieve

GRAVELS, CLEAN GRAVELS

More than half of coarse fraction is larger than No. 4 sieve size, but smaller than 3"

GW Well-graded gravels, gravel and sand mixtures, little or no fines.

GP Poorly graded gravels, gravel and sand mixtures, little or no fines.

GRAVELS WITH FINES (appreciable amount)

GM Silty gravels, poorly graded gravel-sand-silt mixtures.

GC Clay gravels, poorly graded gravel-sand-silt mixtures.

SANDS, CLEAN SANDS

More than half of coarse fraction is smaller than a No. 4 sieve.

SW Well-graded sand, gravelly sands, little or no fines.

SP Poorly graded sands, gravelly sands, little or no fines.

SANDS WITH FINES (appreciable amount)

SM Silty sands, poorly graded sand and silty mixtures.

SC Clayey sands, poorly graded sand and clay mixtures.

FINE-GRAINED

More than half of material is smaller than a No. 200 sieve

SILTS AND CLAYS

ML Inorganic silts and very fine sands, rock flour, sandy silt and clayey-silt sand mixtures with a slight plasticity.

Liquid Limit Less Than 50

CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, clean clays.

OL Organic silts and organic silty clays of low plasticity.

Liquid Limit Greater Than 50

MI Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts

CH Inorganic clays of high plasticity, fat clays

OH Organic clays of medium to high plasticity.

HIGHLY ORGANIC SOILS

PT Peat and other highly organic soils

APPENDIX J
NOISE EVALUATION REPORT

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*phone 760-473-1253
fax 760-689-4943*

August 23, 2016

Mike Matalon
Matalon Architecture and Planning
910 Grand Avenue, Suite #203
San Diego, California 92109

SUBJECT: Noise evaluation for the Mt. Soledad Pump Station Project in San Diego CA

The Mount Soledad Pump Replacement Project (project) includes the construction of a new pump house and replacement of the existing pumps. Soledad Pump Station is the primary pump station within the City's Soledad 925 Pressure Zone (PZ) which feeds the community of La Jolla, see Figure 1 in Attachment A. The City prepared a Soledad Pump Station Planning Study, which determined the pump station has reached the end of its life cycle and requires replacement. The current pump station only has two of its three pumps operational and these pumps operate at less than 65% efficiency, which is well below industry standard.

The proposed facilities include a new pump station, upgrades to the reservoir, new site piping, new altitude valve and appurtenances, widened access road and driveway, security upgrades and landscape and irrigation replacement. The pump station will be a completely new station housing four vertical turbine pumps, valves, piping appurtenances, controls and electrical in a new concrete masonry unit (CMU) building. The pumps will operate in various combinations to meet the changing demands within the 925 pressure zone.

The new structure will be partially below-grade and will be retaining a large portion of soil for the existing site on the downslope side of the existing Soledad Reservoir. The pump room will have an 11' floor to ceiling height with an interior layout providing for a minimum of 3' clear between pumps, piping, appurtenances, walls, etc.

The purpose of this analysis is to provide an understanding of the key issues affected by the proposed project and provide information of potential impacts and mitigation measures with respect to noise issues.

Terminology

The impact of noise is not a function of loudness alone. The time of day when noise occurs and the duration of the noise are also important. In addition, most noise that lasts for more than a few seconds is variable in its intensity. Consequently, a variety of noise descriptors

have been developed. The noise descriptors used for this study are the 1-hour equivalent noise level (L_{eq}) and the CNEL.

The L_{eq} is the average A-weighted decibel (dBA) sound level over a one-hour period. The CNEL is a 24-hour A-weighted average sound level (dBA L_{eq}) from midnight to midnight obtained after the addition of 5 decibels (dB) to sound levels occurring between 7:00 P.M. and 10:00 P.M., and 10 dB to sound levels occurring between 10:00 P.M. and 7:00 A.M. A-weighting is a frequency correction that often correlates well with the subjective response of humans to noise. Adding 5 dB and 10 dB to the evening and nighttime hours, respectively, accounts for the added sensitivity of humans to noise during these time periods.

Sound from a small localized source (approximating a "point" source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level decreases or drops off at a rate of 6 dBA for each doubling of the distance.

However, traffic noise is not a single, stationary point source of sound. The movement of vehicles makes the source of the sound appear to emanate from a line (line source) rather than a point when viewed over some time interval. The drop-off rate for a line source is 3 dBA for each doubling of distance.

Change in noise levels is perceived as follows: 3 dBA barely perceptible, 5 dBA readily perceptible, and 10 dBA perceived as a doubling or halving of noise (California Department of Transportation [Caltrans] 2009).

Applicable Standards and Regulations

Section 59.5.0401 of the City's Noise Abatement and Control Ordinance states that:

- A. It shall be unlawful for any person to cause noise by any means to the extent that the one-hour average sound level exceeds the applicable limit.
- B. The sound level limit at a location on a boundary between two zoning districts is the arithmetic mean of the respective limits for the two districts.

The applicable noise limits are summarized in Table 1. The surrounding properties are zoned the same RS-1-2. The on-site use is institutional/industrial not residential. Additionally, the property directly east of the proposed pump house is open space maintained by the La Jolla Scenic Drive Home owners Association and is not used for residential purposes.

Based on the lands use categories identified in Table 1, the applicable noise limits between the project site and the neighboring uses are 62.5 dBA L_{eq} between 7:00 A.M. and 7:00 P.M., and 60 dBA L_{eq} between 7:00 P.M. and 10:00 P.M., and 57.5 dBA L_{eq} between 10:00 P.M. and 7:00 A.M.

Table 1: Applicable Noise Level Limits

Land Use	Time of Day	One-Hour Average Sound Level (dBA L _{eq})
Single-family Residential	7:00 A.M. to 7:00 P.M.	50
	7:00 P.M. to 10:00 P.M.	45
	10:00 P.M. to 7:00 A.M.	40
Multi-family Residential (up to a maximum density of 1 unit/2,000 square feet)	7:00 A.M. to 7:00 P.M.	55
	7:00 P.M. to 10:00 P.M.	50
	10:00 P.M. to 7:00 A.M.	45
All Other Residential	7:00 A.M. to 7:00 P.M.	60
	7:00 P.M. to 10:00 P.M.	55
	10:00 P.M. to 7:00 A.M.	50
Commercial	7:00 A.M. to 7:00 P.M.	65
	7:00 P.M. to 10:00 P.M.	60
	10:00 P.M. to 7:00 A.M.	60
Industrial or Agricultural	Anytime	75

Existing Setting

Existing noise level measurements were conducted between the hours of 1:00 p.m. and 2:00 p.m. on June 14, 2016. Noise measurements were taken with a Larson Davis Model LxT Type 1 sound level meter set on "slow" response and "A-weighting." The meter was positioned 5 feet above the existing ground elevation at all measurement locations. The sound level meter was calibrated before and after each measurement using a Larson-Davis calibrator, Model CAL 200.

Table 2: Summary of Noise Level Measurements

ID	Location Description	Noised Level (dBA)		
		L _{eq}	L _{min}	L _{max}
1	1 ft. from ventilation louver	65.4	63.6	67.8
2	3 ft. from ventilation louver	61.8	60.9	62.4
3	6 feet from pump (direct line of sight with no shielding)	82.8	81.9	83.7
4	Near property line approximately 6 feet from building	51.7	50.4	52.7

Impact Analysis

Operational Noise

Noise levels from the proposed operation activities were modeled with SoundPLAN Essential, version 3.0, a three-dimensional acoustical modeling software package (Braunstein + Berndt GmbH 2015). Propagation of modeled stationary noise sources was based on ISO Standard 9613-2, "Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation." The model includes digital terrain modeling, which allows the calculation to take topography into account. The terrain model was developed from project specific topographical data. The ISO Standard 9613-2 assumes that all receptors would be downwind of stationary sources. This is a worst-case assumption for total noise impacts, since, in reality, only some receptors will be downwind at any one time.

Typical increases or decreases of sound levels depend on the ground absorption factor between the source and receiver. Acoustically hard sites include surfaces, such as pavement, bare hard ground, water, and ice, with high reflectivity (i.e., 0.0 absorption). A higher ground factor defines more absorptive ground, such as vegetation or tilled and loose soil (typically 0.5 to 1.0). Based on field observations, the site is considered acoustically soft, or absorptive, therefore, an acoustic ground factor of 0.75 was used for modeling.

Reference Noise Levels

Sound power reference data was taken from the *Flowserve Pump Sound and Vibration Reference Manual for Single and two stage, end suction and axially split volute type centrifugal pumps*, see Attachment C. Based on the Flowserve Reference Manual a 40 horsepower (HP) pump motor would generate approximately 73 dBA at 1,800 revolutions per minute (RPM) and a 100 HP motor would generate approximately 77 dBA at 1,800 RPM. For modeling purposes, it was assumed as a worst case all 4 four pumps (two at 40 HP and two at 100 HP) would potentially operate for an entire hour. For modeling nighttime noise levels it was assumed one 40 HP and one 100 HP pump would be operational. The modeled source noise levels are presented in Table 3 on the following page.

Mechanical equipment, i.e. pumps, would be a primary on-site noise source associated with the project. As with the existing pumps, the equipment would be located inside the pump house. Based on the existing building and louver, it is estimated the future structure would provide approximately 30 dB attenuation. Based on observations and measurements of the existing facility, the weak point from a noise perspective would be at openings for ventilation. Thus, for modeling purposes, the primary source of noise would be ventilation louvers. Based on project plans, the louvers would be located on the northwest corner of the building, facing west. The ground level elevations were taken from the project plans and equipment heights

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were taken from project plans and specification sheets. Locations of receivers and noise sources are shown in Figure 2. The noise measurement sheets are included in Attachment B.

The results of the modeling are provided in Figures 3a and 3b for the daytime/evening and nighttime operation. Daytime/evening operation is based on two pumps operating simultaneously for an entire hour and the nighttime operation is based on one pump in operation between 10:00 PM and 7:00 AM due to lower demand during these hours. Results of the noise modeling are shown in Table 3.

Table 3: Modeled Noise Levels

Receiver (Address)	Noise Level Limits	Daytime/Evening Noise Level	Nighttime Noise Levels
1 (6749 La Jolla Scenic Dr.)	62.5/60/57.5	15	12
2 (6735 La Jolla Scenic Dr.)	62.5/60/57.5	34	31
3a (No Address – Open space)	NA	38	35
3b (No Address – Open space)	NA	35	32
4 (6805 La Jolla Scenic Dr.)	62.5/60/57.5	23	20

As shown in Table 3 and Figures 3a and 3b, noise levels at the adjacent properties would not exceed the daytime, evening, or nighttime noise level limits at the property line. If you have any questions, please do not hesitate to contact me directly at (760) 473-1253 or jlouden@ldnconsulting.net.

Sincerely, Ldn Consulting



Jeremy Loudon, Principal

Attachments: **A** - Figures
 B - Ambient Noise Results
 C - Pump Noise Levels

Attachment A
Figures

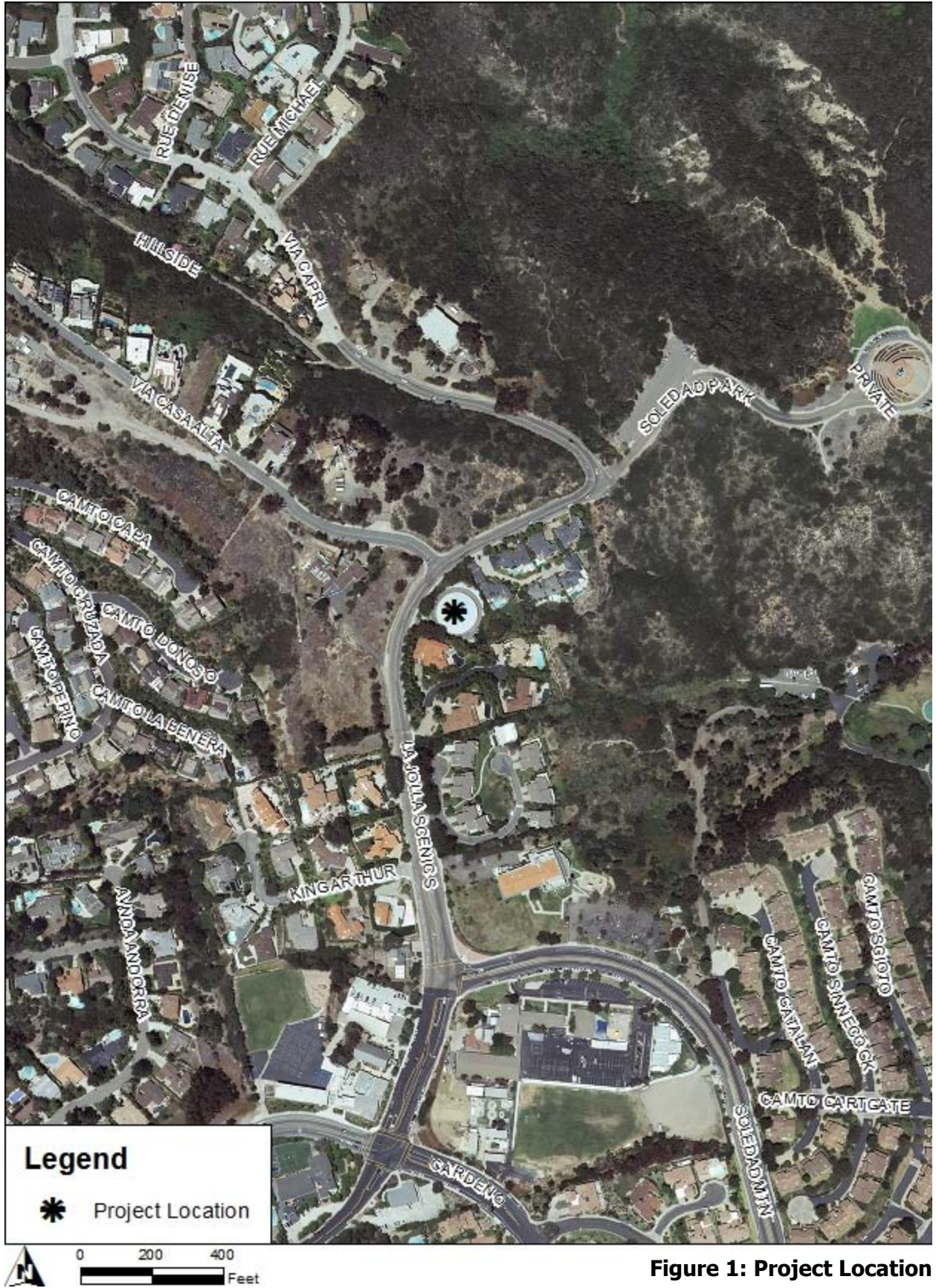


Figure 1: Project Location





Figure 3A: Daytime and Evening Noise Level Contours



Figure 3B: Nighttime Noise Level Contours

Attachment B
Noise Measurement Data

General Information			
Serial Number			02412
Model			LxT1
User			
Job Description			
Location			
File Name			LxT_Data.081
Start Time		Tuesday, 2016 June 14	13:27:28
Stop Time		Tuesday, 2016 June 14	13:28:28
Run Time			00:01:00
Pre Calibration		Tuesday, 2016 June 14	13:21:25
Post Calibration			None
Calibration Deviation			---

Note

Overall Data			
Leq			65.4 dBA
Lmax	(14 Jun 2016 13:27:31)		67.8 dBA
Lpeak (max)	(14 Jun 2016 13:27:30)		78.8 dBA
Lmin	(14 Jun 2016 13:28:14)		63.6 dBA
LE			83.2 dBA
SE			23.4 $\mu\text{Pa}^2\text{hr}$
SE(8)			11.2 mPa^2hr
SE(40)			55.9 mPa^2hr
Overload?			No

Statistics			
L5.0			67.5 dBA
L10.0			67.2 dBA
L33.3			65.6 dBA
L50.0			64.9 dBA
L66.6			64.6 dBA
L90.0			63.8 dBA
Event Counts (SPL Trigger 85.0 dB)			0
Event Counts (SPL Trigger 115.0 dB)			0
Event Counts (Lpeak Trigger 135.0 dB)			0

Dose			
Name	OSHA-1	OSHA-2	
Dose	0.0	0.0	%
Projected Dose	0.0	0.0	%
Projected TWA	---	---	dBA
TWA (8)	---	---	dBA
Lep (8)	38.6	38.6	dBA

Settings			
Exchange Rate	5	5	
Threshold	90	80	dBA
Criterion Level	90.0	90.0	dBA
Criterion Duration	8.0	8.0	hours
RMS Weight			A Weighting
Peak Weight			A Weighting
Detector			Slow
Preamp			PRMLXT1L
Integration Method			Linear
OBA Range			Normal
OBA Bandwidth			1/1 and 1/3

1/1 Spectra

Freq. (Hz)	8.0	16.0	31.5	63.0	125	250	500	1000	2000	4000	8000	16K
Leq	7.3	8.8	21.7	32.7	40.4	47.6	50.3	54.3	64.2	55.9	46.2	29.2
Max	7.3	12.6	22.7	35.1	41.6	48.1	52.5	54.7	67.0	57.1	48.9	29.8
Min	7.3	4.6	9.9	30.5	37.2	43.6	49.5	48.6	61.5	54.8	45.4	28.7

1/3 Spectra

Freq. (Hz)	6.3	8.0	10.0	12.5	16.0	20.0	25.0	31.5	40.0	50.0	63.0	80.0
Leq	3.3	2.3	1.7	0.6	4.5	6.6	11.4	15.5	19.9	23.5	28.5	29.7
Max	3.3	2.3	1.7	0.6	8.4	8.1	11.6	17.3	21.8	27.0	33.1	32.9
Min	3.3	2.3	1.7	0.6	-0.2	-1.0	1.4	10.3	16.4	19.9	24.7	27.4

Freq. (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250
Leq	34.1	35.0	37.1	39.2	42.3	45.4	45.2	45.8	45.5	47.3	50.5	50.2
Max	38.4	37.9	37.5	39.7	44.3	46.2	46.4	46.9	51.6	48.1	50.9	50.8
Min	27.8	32.1	36.0	35.3	40.8	41.4	43.6	39.6	43.9	46.3	47.3	47.8

Freq. (Hz)	1600	2000	2500	3150	4000	5000	6300	8000	10K	12.5K	16K	20K
Leq	52.7	62.3	58.8	50.3	53.4	47.4	44.5	40.5	33.4	27.9	20.0	14.1
Max	54.3	65.4	61.5	52.6	54.9	48.8	47.0	41.6	34.6	27.7	20.6	14.2
Min	51.3	58.4	57.2	49.2	52.1	46.3	43.4	39.6	32.7	26.7	19.2	12.9

General Information			
Serial Number			02412
Model			LxT1
User			
Job Description			
Location			
File Name			LxT_Data.082
Start Time		Tuesday, 2016 June 14	13:32:22
Stop Time		Tuesday, 2016 June 14	13:33:21
Run Time			00:00:59
Pre Calibration		Tuesday, 2016 June 14	13:21:25
Post Calibration			None
Calibration Deviation			---

Note

Overall Data			
Leq			61.8 dBA
Lmax	(14 Jun 2016 13:32:52)		62.4 dBA
Lpeak (max)	(14 Jun 2016 13:32:51)		74.9 dBA
Lmin	(14 Jun 2016 13:32:42)		60.9 dBA
LE			79.5 dBA
SE			10.0 $\mu\text{Pa}^2\text{hr}$
SE(8)			4.8 mPa^2hr
SE(40)			24.0 mPa^2hr
Overload?			No

Statistics			
L5.0			62.2 dBA
L10.0			62.1 dBA
L33.3			61.9 dBA
L50.0			61.7 dBA
L66.6			61.6 dBA
L90.0			61.3 dBA
Event Counts (SPL Trigger 85.0 dB)			0
Event Counts (SPL Trigger 115.0 dB)			0
Event Counts (Lpeak Trigger 135.0 dB)			0

Dose			
Name	OSHA-1	OSHA-2	
Dose	0.0	0.0	%
Projected Dose	0.0	0.0	%
Projected TWA	---	---	dBA
TWA (8)	---	---	dBA
Lep (8)	34.9	34.9	dBA

Settings			
Exchange Rate	5	5	
Threshold	90	80	dBA
Criterion Level	90.0	90.0	dBA
Criterion Duration	8.0	8.0	hours
RMS Weight			A Weighting
Peak Weight			A Weighting
Detector			Slow
Preamp			PRMLXT1L
Integration Method			Linear
OBA Range			Normal
OBA Bandwidth			1/1 and 1/3

1/1 Spectra												
Freq. (Hz)	8.0	16.0	31.5	63.0	125	250	500	1000	2000	4000	8000	16K
Leq	7.3	6.0	20.1	32.1	38.7	44.9	46.6	48.3	60.6	53.0	43.9	27.7
Max	7.3	6.9	21.8	34.1	39.3	45.1	46.8	48.9	61.4	53.1	44.6	27.4
Min	7.3	4.6	17.4	19.9	29.6	43.7	45.4	46.8	59.5	52.1	42.8	26.5
1/3 Spectra												
Freq. (Hz)	6.3	8.0	10.0	12.5	16.0	20.0	25.0	31.5	40.0	50.0	63.0	80.0
Leq	3.3	2.3	1.7	0.6	-0.1	4.2	9.1	13.5	18.6	23.9	27.7	29.0
Max	3.3	2.3	1.7	0.6	-0.2	6.8	9.9	15.0	20.4	24.7	29.9	30.5
Min	3.3	2.3	1.7	0.6	-0.2	-1.0	2.0	9.7	15.0	9.1	22.0	26.4
Freq. (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250
Leq	30.6	34.1	35.5	38.1	41.6	40.2	42.1	41.9	41.7	43.1	43.6	43.9
Max	32.0	34.0	36.6	38.8	41.8	40.5	42.8	42.3	42.0	43.2	43.8	45.4
Min	27.8	31.4	33.6	18.5	39.8	38.7	40.4	33.2	33.0	42.2	42.4	40.2
Freq. (Hz)	1600	2000	2500	3150	4000	5000	6300	8000	10K	12.5K	16K	20K
Leq	50.1	57.7	56.7	44.3	51.0	46.2	41.3	40.1	30.8	26.4	19.4	13.7
Max	49.6	58.8	57.6	44.6	51.2	47.1	42.3	41.1	30.2	26.0	19.4	13.5
Min	47.4	54.7	55.3	42.5	49.6	44.9	39.7	37.0	29.1	25.1	18.0	12.8

General Information			
Serial Number			02412
Model			LxT1
User			
Job Description			
Location			
File Name			LxT_Data.080
Start Time		Tuesday, 2016 June 14	13:25:21
Stop Time		Tuesday, 2016 June 14	13:26:22
Run Time			00:01:00
Pre Calibration		Tuesday, 2016 June 14	13:21:25
Post Calibration			None
Calibration Deviation			---

Note

Overall Data			
Leq			82.8 dBA
Lmax	(14 Jun 2016 13:25:57)		83.7 dBA
Lpeak (max)	(14 Jun 2016 13:25:57)		96.9 dBA
Lmin	(14 Jun 2016 13:26:15)		81.9 dBA
LE			100.6 dBA
SE			1.3 mPa ² hr
SE(8)			606.1 mPa ² hr
SE(40)			3.0 Pa ² hr
Overload?			No

Statistics			
L5.0			83.4 dBA
L10.0			83.2 dBA
L33.3			83.0 dBA
L50.0			82.8 dBA
L66.6			82.7 dBA
L90.0			82.3 dBA
Event Counts (SPL Trigger 85.0 dB)			0
Event Counts (SPL Trigger 115.0 dB)			0
Event Counts (Lpeak Trigger 135.0 dB)			0

Dose			
Name	OSHA-1	OSHA-2	
Dose	0.0	0.1	%
Projected Dose	0.0	36.8	%
Projected TWA	---	82.8	dBA
TWA (8)	---	38.3	dBA
Lep (8)	56.0	56.0	dBA

Settings			
Exchange Rate	5	5	
Threshold	90	80	dBA
Criterion Level	90.0	90.0	dBA
Criterion Duration	8.0	8.0	hours
RMS Weight			A Weighting
Peak Weight			A Weighting
Detector			Slow
Preamp			PRMLXT1L
Integration Method			Linear
OBA Range			Normal
OBA Bandwidth			1/1 and 1/3

1/1 Spectra												
Freq. (Hz)	8.0	16.0	31.5	63.0	125	250	500	1000	2000	4000	8000	16K
Leq	7.3	8.6	25.2	37.5	46.5	55.3	60.5	65.3	82.0	73.3	63.4	45.2
Max	7.3	15.3	36.7	45.7	55.6	60.1	67.4	72.3	82.7	73.3	63.9	48.4
Min	7.3	4.6	17.9	34.0	44.0	53.9	59.3	63.8	81.0	72.5	62.0	44.6
1/3 Spectra												
Freq. (Hz)	6.3	8.0	10.0	12.5	16.0	20.0	25.0	31.5	40.0	50.0	63.0	80.0
Leq	3.3	2.3	1.8	0.8	0.7	8.0	15.6	18.8	23.4	28.9	30.2	35.9
Max	3.3	2.3	1.7	3.0	8.9	13.4	17.4	31.7	34.8	37.7	40.4	43.5
Min	3.3	2.3	1.7	0.6	-0.2	-0.5	8.5	11.6	14.0	25.1	25.1	31.7
Freq. (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250
Leq	37.6	42.1	43.4	48.0	51.1	51.9	54.5	56.2	56.4	60.2	60.7	61.1
Max	49.6	53.0	48.8	52.9	57.0	57.3	62.9	61.9	63.9	66.7	66.6	69.1
Min	31.3	38.8	40.7	44.7	48.7	50.2	52.4	54.7	55.0	58.3	59.2	57.6
Freq. (Hz)	1600	2000	2500	3150	4000	5000	6300	8000	10K	12.5K	16K	20K
Leq	66.7	81.0	75.3	62.2	72.2	65.6	62.1	57.2	50.5	43.1	36.2	26.7
Max	69.9	81.6	75.9	65.0	72.2	65.2	62.5	57.4	51.3	43.9	45.2	29.0
Min	65.2	79.8	74.4	61.1	71.2	64.1	60.4	56.1	49.8	42.4	34.7	26.0

General Information			
Serial Number			02412
Model			LxT1
User			
Job Description			
Location			
File Name			LxT_Data.086
Start Time		Tuesday, 2016 June 14	13:40:31
Stop Time		Tuesday, 2016 June 14	13:41:14
Run Time			00:00:37
Pre Calibration		Tuesday, 2016 June 14	13:21:25
Post Calibration			None
Calibration Deviation			---

Note

Overall Data			
Leq			51.7 dBA
Lmax	(14 Jun 2016 13:41:14)		52.7 dBA
Lpeak (max)	(14 Jun 2016 13:40:54)		65.2 dBA
Lmin	(14 Jun 2016 13:40:31)		50.4 dBA
LE			67.5 dBA
SE			0.6 $\mu\text{Pa}^2\text{hr}$
SE(8)			475.4 $\mu\text{Pa}^2\text{hr}$
SE(40)			2.4 mPa^2hr
Overload?			No

Statistics			
L5.0			52.4 dBA
L10.0			52.2 dBA
L33.3			51.7 dBA
L50.0			51.6 dBA
L66.6			51.4 dBA
L90.0			51.2 dBA
Event Counts (SPL Trigger 85.0 dB)			0
Event Counts (SPL Trigger 115.0 dB)			0
Event Counts (Lpeak Trigger 135.0 dB)			0

Dose			
Name	OSHA-1	OSHA-2	
Dose	0.0	0.0	%
Projected Dose	0.0	0.0	%
Projected TWA	---	---	dBA
TWA (8)	---	---	dBA
Lep (8)	22.9	22.9	dBA

Settings			
Exchange Rate	5	5	
Threshold	90	80	dBA
Criterion Level	90.0	90.0	dBA
Criterion Duration	8.0	8.0	hours
RMS Weight			A Weighting
Peak Weight			A Weighting
Detector			Slow
Preamp			PRMLXT1L
Integration Method			Linear
OBA Range			Normal
OBA Bandwidth			1/1 and 1/3

1/1 Spectra												
Freq. (Hz)	8.0	16.0	31.5	63.0	125	250	500	1000	2000	4000	8000	16K
Leq	7.3	7.6	21.5	37.0	37.8	38.0	36.7	38.2	50.1	41.9	34.4	17.7
Max	7.3	6.5	21.4	41.2	35.8	37.2	35.8	36.8	51.1	43.6	34.2	18.0
Min	7.3	4.6	15.9	25.3	35.0	36.5	31.7	34.4	49.2	39.8	33.5	17.1
1/3 Spectra												
Freq. (Hz)	6.3	8.0	10.0	12.5	16.0	20.0	25.0	31.5	40.0	50.0	63.0	80.0
Leq	3.3	2.3	1.7	0.7	2.3	5.3	11.1	16.6	19.1	23.9	35.5	30.8
Max	3.3	2.3	1.7	0.6	4.3	3.5	12.5	17.3	19.3	24.5	41.0	30.9
Min	3.3	2.3	1.7	0.6	-0.2	-1.0	3.7	9.9	5.3	18.7	20.9	27.6
Freq. (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250
Leq	31.1	34.7	32.3	33.8	34.0	31.4	29.8	31.6	33.5	34.6	33.2	32.7
Max	27.3	32.9	31.1	32.7	33.7	31.6	30.2	31.4	32.1	33.1	32.1	31.6
Min	25.4	31.9	28.5	31.4	30.3	29.5	27.9	20.2	27.4	32.4	26.6	31.2
Freq. (Hz)	1600	2000	2500	3150	4000	5000	6300	8000	10K	12.5K	16K	20K
Leq	36.5	48.4	44.7	32.3	40.2	35.3	33.5	26.5	19.5	15.1	11.5	9.7
Max	36.1	48.9	46.9	31.4	42.2	37.9	33.0	27.4	19.5	15.5	11.9	9.5
Min	35.2	47.2	43.1	30.2	38.3	29.6	31.6	25.8	18.6	14.3	11.1	9.5

Attachment C
Pump Noise Leve Data

Table I

Motor size and speed kW (hp)	Typical sound pressure level, dBA, L _{PA} at 1 m, reference 20 µPa							
	3500 r/min		2900 r/min		1750 r/min		1450 r/min	
	Pump only	Pump and motor	Pump only	Max Pump & motor	Pump only	Pump and motor	Pump only	Max Pump & motor
	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
<0.55 (<0.75)	72	72	64	65	62	64	62	64
0.75 (1)	72	72	64	66	62	64	62	64
1.1 (1.5)	74	74	66	67	64	64	62	63
1.5 (2)	74	74	66	71	64	64	62	63
2.2 (3)	75	76	68	72	65	66	63	64
3 (4)	75	76	70	73	65	66	63	64
4 (5)	75	76	71	73	65	66	63	64
5.5 (7.5)	76	77	72	75	66	67	64	65
7.5 (10)	76	77	72	75	66	67	64	65
11 (15)	80	81	76	78	70	71	68	69
15 (20)	80	81	76	78	70	71	68	69
18.5 (25)	81	81	77	78	71	71	69	71
22 (30)	81	81	77	79	71	71	69	71
30 (40)	83	83	79	81	73	73	71	73
37 (50)	83	83	79	81	73	73	71	73
45 (60)	86	86	82	84	76	76	74	76
55 (75)	86	86	82	84	76	76	74	76
75 (100)	87	87	83	85	77	77	75	77
90 (120)	87	88	83	85	77	78	75	78
110 (150)	89	90	85	87	79	80	77	80
132(175)	89	90	85	87	79	80	77	80
150 (200)	89	90	85	87	79	80	77	80
160(215)	(1)	(1)	(1)	(1)	83	84	81	83
200 (270)	(1)	(1)	(1)	(1)	85	87	83	85
250(335)	(1)	(1)	(1)	(1)	86	89	84	86
300(400)					87	90	85	86
315(422)					87	90	85	86
355(475)					87	90	86	87
500(670)					88	(1)	86	(1)
1000(1300)					90	(1)	88	(1)
1500(2000)					90	(1)	90	(1)

(1) Noise levels of machines in this range should be based on actual equipment selected

For 1180 and 960 r/min reduce the 1450 r/min values by 2dBA

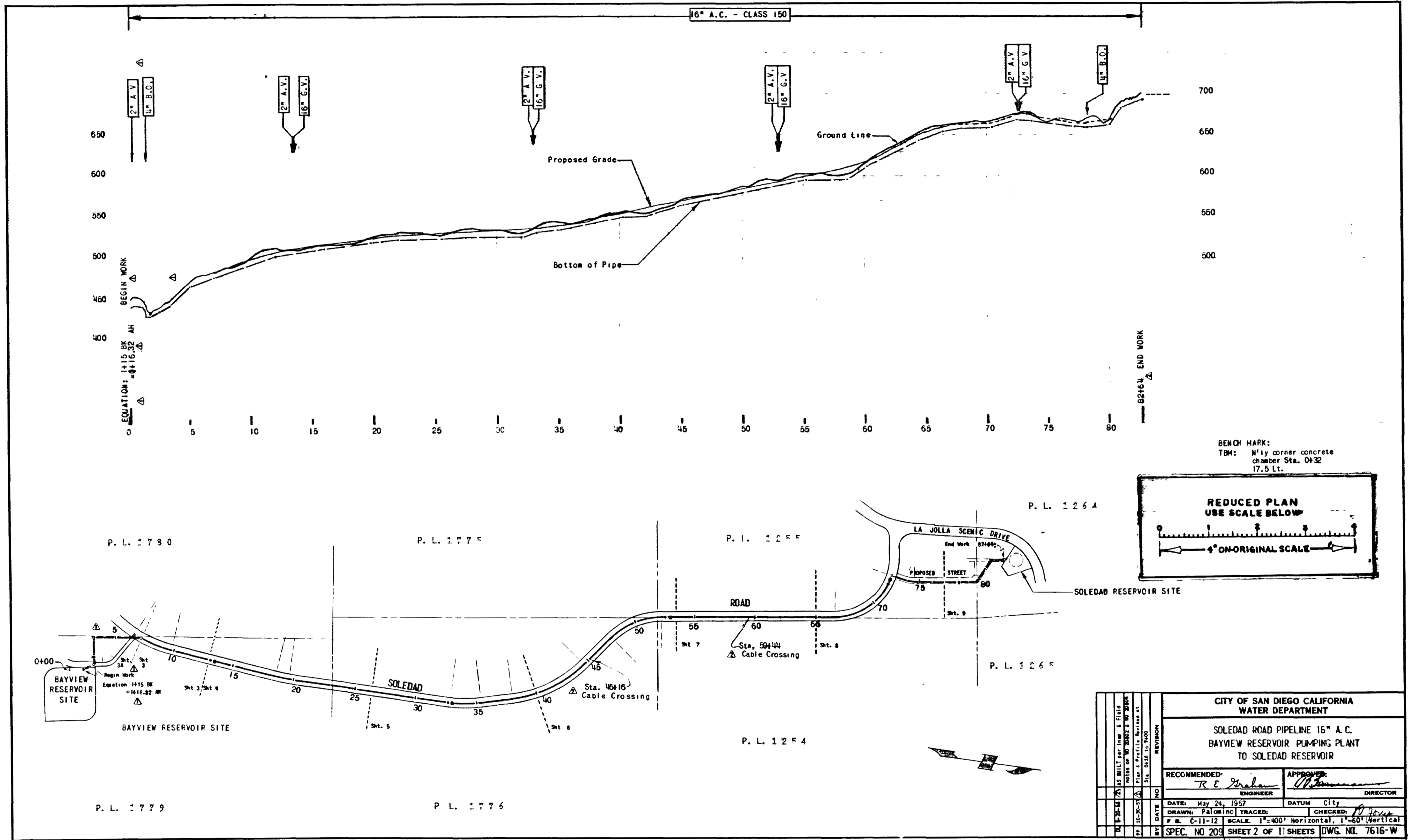
For 880 and 720 r/min reduce the 1450 r/min values by 3dBA

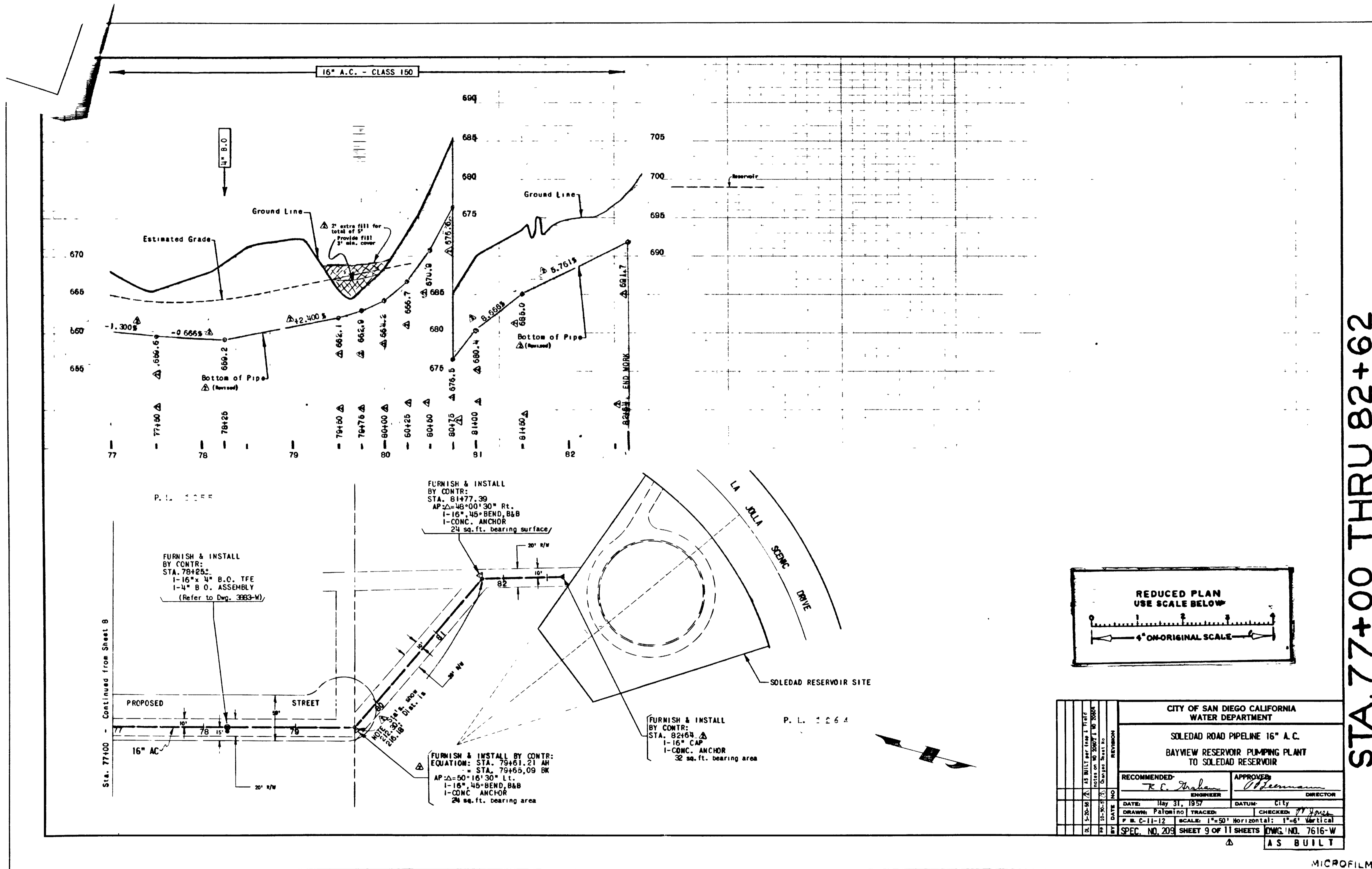
Table II

Octave band mid frequency Hz	31.5	63	125	250	500	1K	2K	4K	8K
Line 1 To correct linear values to 'A' Weighted add these values to the linear number, noting the sign	-37	-26	-16	-9	-3	0	+1	+1	-1
Line 2 For an approximation of octave band values in 'A' weighted form subtract these values from the overall dBA value	48	33	23	15	8	6	5	9	16
Line 3 For an approximation of octave band values in 'Linear' form subtract these values from the overall dBA value	11	7	7	6	5	6	6	10	15

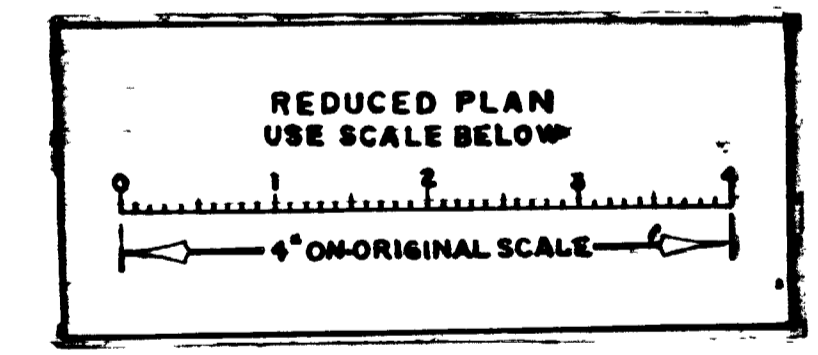
APPENDIX K

AS-BUILTS

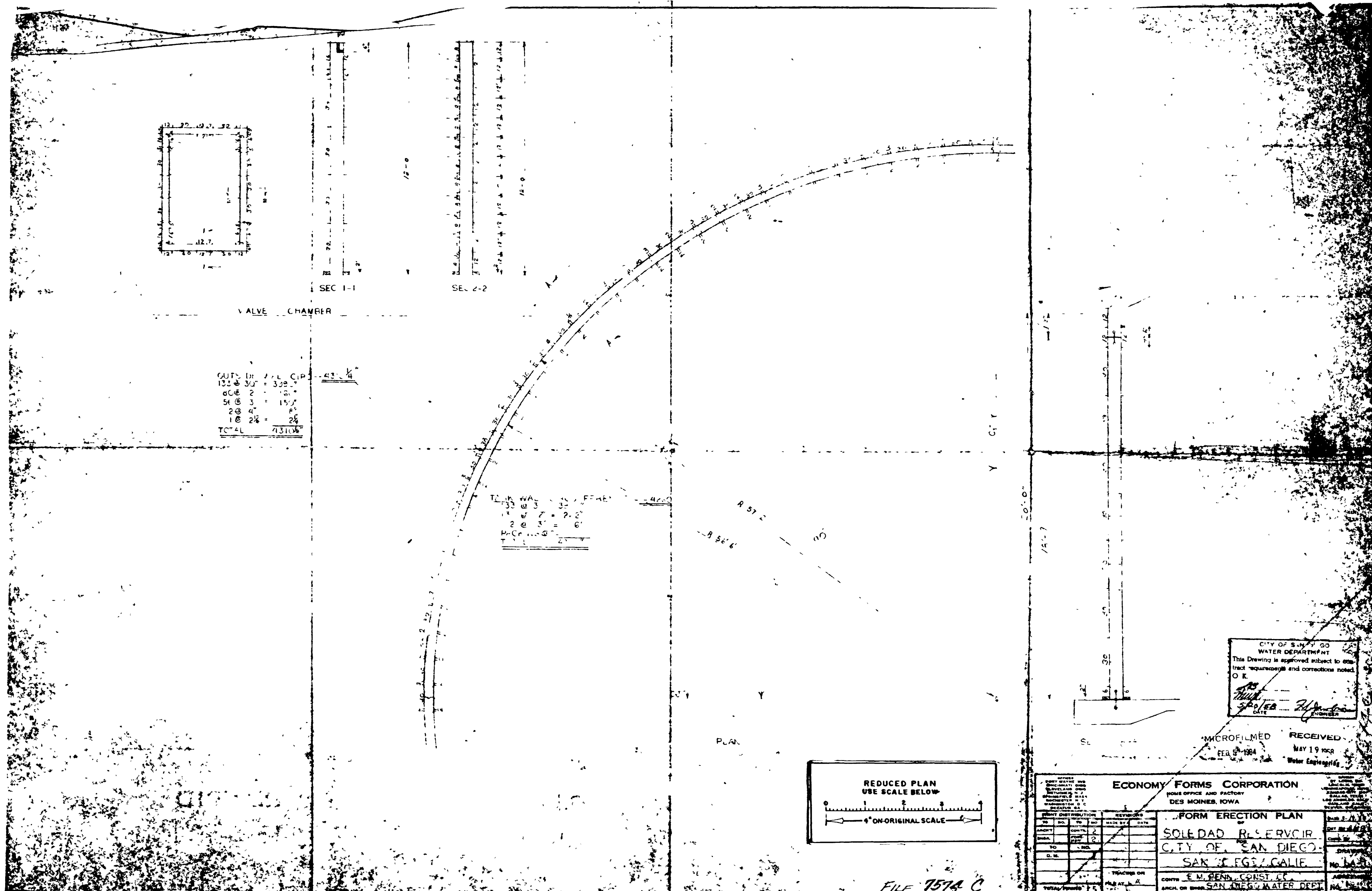


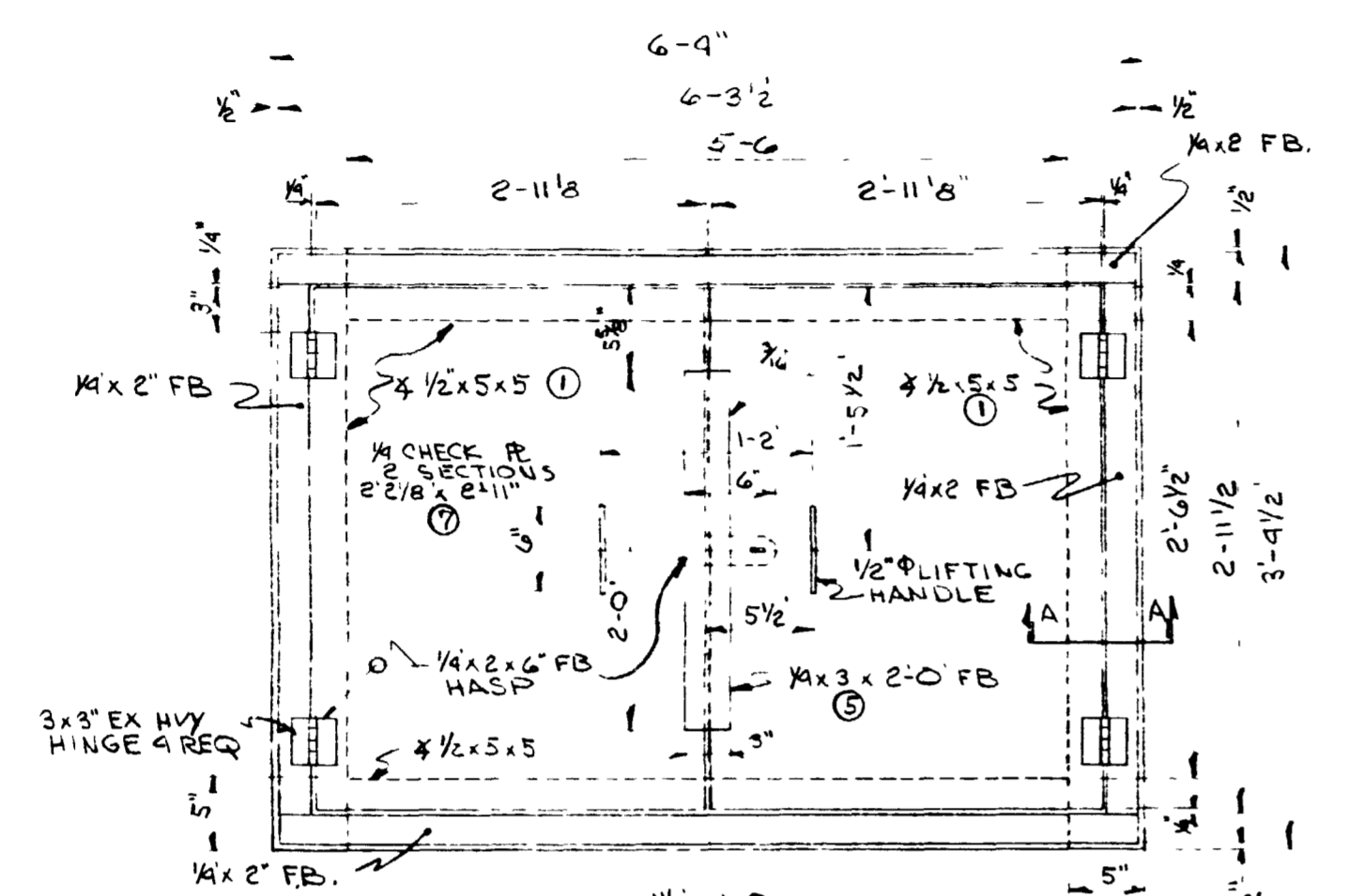


STA. 77+00 THRU 82+62

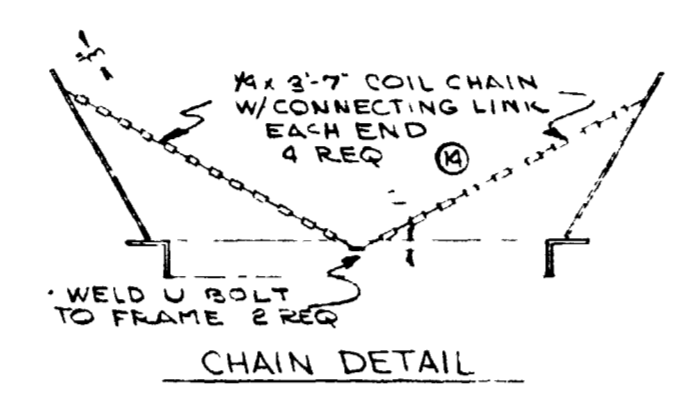


CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT	
SOLEDAD ROAD PIPELINE 16" A.C. BAYVIEW RESERVOIR PUMPING PLANT TO SOLEDAD RESERVOIR	
RECOMMENDED: <i>R. C. Graham</i> ENGINEER	APPROVED: <i>V. J. ...</i> DIRECTOR
DATE: May 31, 1957	DATUM: City
DRAWN: Patonino	CHECKED: <i>W. ...</i>
P. B. C-11-12	SCALE: 1"=50' Horizontal; 1"=6' Vertical
SPEC. NO. 209 SHEET 9 OF 11 SHEETS DWG. NO. 7616-W	
AS BUILT	

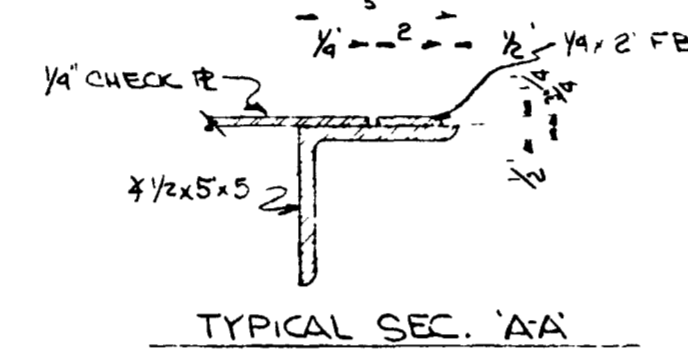




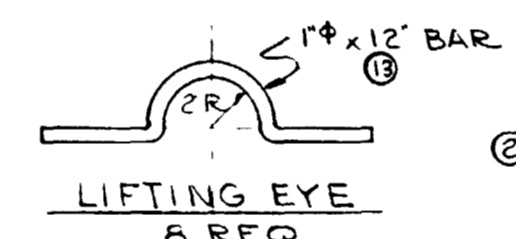
PLAN & ELEVATION OF ROOF HATCH
1 REQ



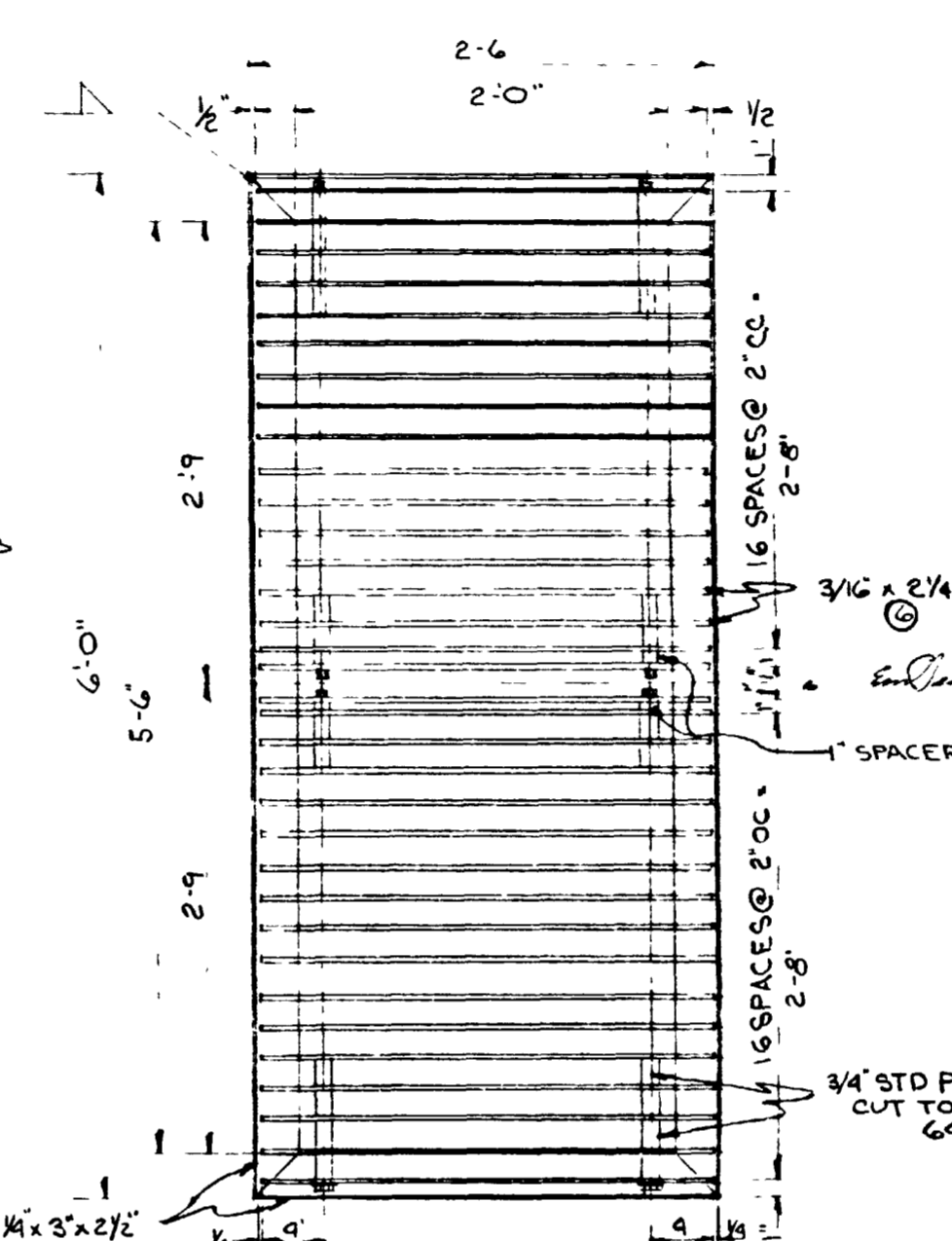
CHAIN DETAIL



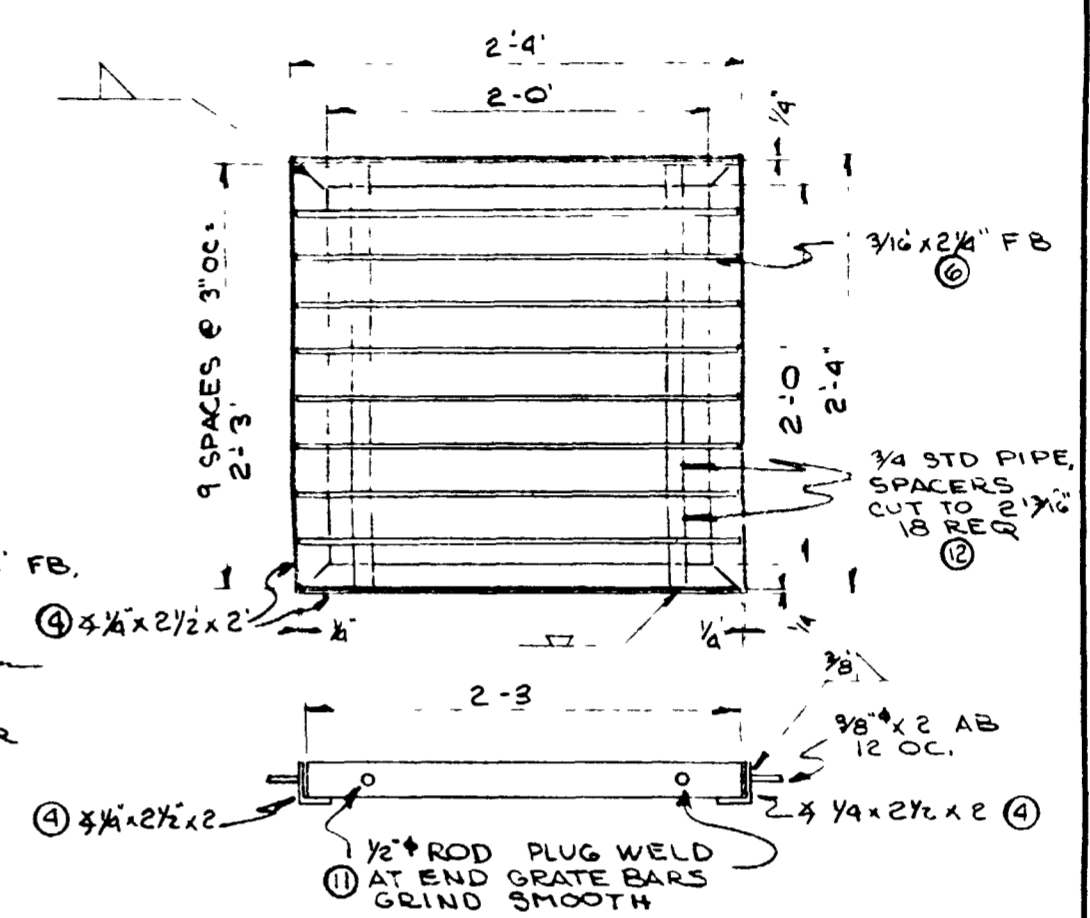
TYPICAL SEC. 'AA'



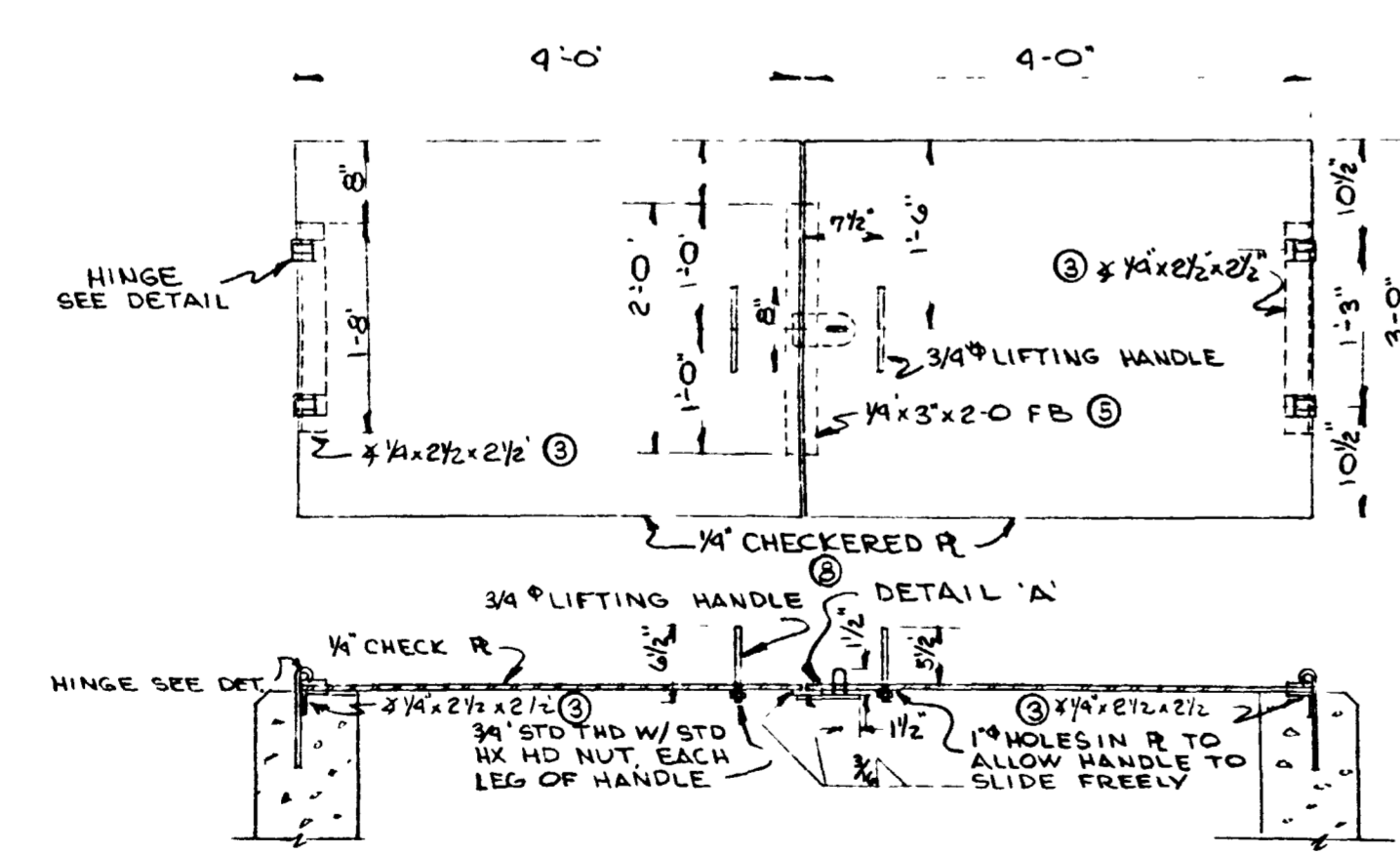
LIFTING EYE
8 REQ



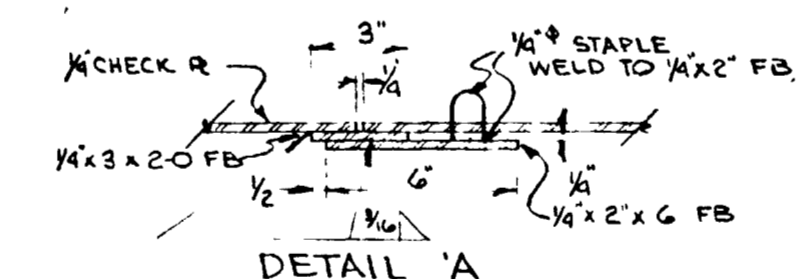
PLAN & ELEV INSPECTION BOX GRATE
1 REQ
DO NOT SCALE



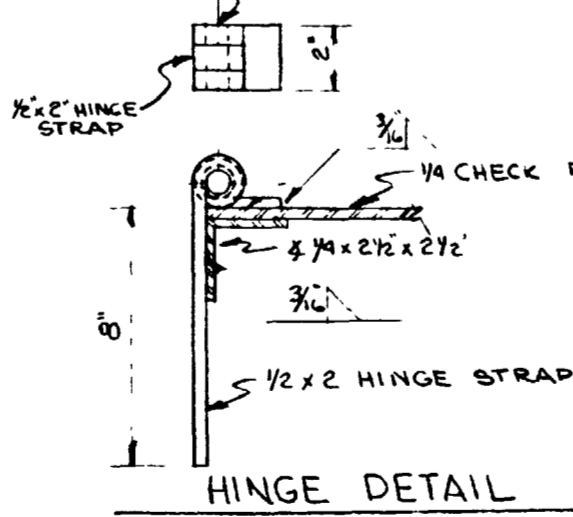
PLAN & ELEV. FLOOR DRAIN GRATE
1 REQ



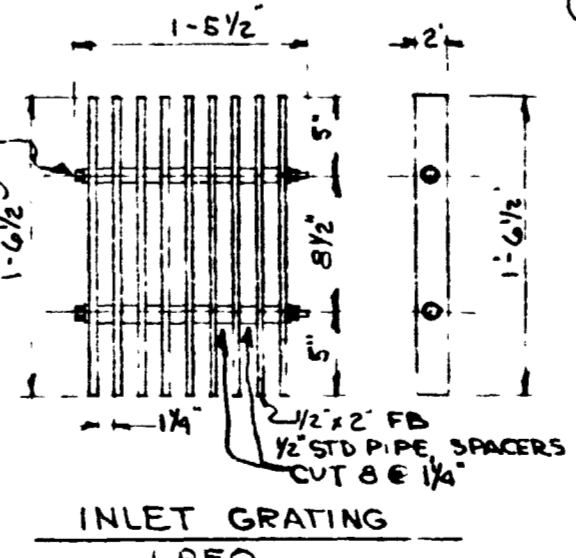
PLAN & ELEVATION OF VALVE CHAMBER HATCH
1 REQ



DETAIL 'A'



HINGE DETAIL



INLET GRATING
1 REQ

CITY OF SAN DIEGO
WATER DEPARTMENT
This Drawing is approved for construction only if accompanied by a permit issued by the City of San Diego.
MMA
5/11/87

PART NO.	DESCRIPTION	SHIP PRCES	TOTAL PRCES FOR ONE	FT	LN	MAT'L	REMARKS
14	1/4" COIL CHAIN		14	4			ROOF HATCH
13	1" BAR		8	0			LIFTING EYE
12	3/4" STD PIPE		9	10			PIPE SPACERS
11	1/2" ROD	2	2	2	3/4		FLOOR DRAIN
10	1/2" ROD	4	4	2	10		INS BOX
9	1/2" HX HD BOLT	2	2	1	5/8		INLET GRATE
8	1/4" CHECKERED R						8'-0" x 3'-0"
7	1/4" CHECKERED R						5'-10 1/4" x 2'-11"
6	FB 3/16" x 2 1/4"		82	2			GRATE BARS
5	FB 1/4" x 3"		4	0			
4	1/4" x 2 1/2" x 2"	4	4	9	4		FLR DRAIN FRM.
3	1/4" x 2 1/2" x 2 1/2"	2	2	3	4		VALVE CHAMBER
2	1/4" x 3" x 2 1/2"		17	0			INS BOX FRM.
1	1/2" x 5" x 5"		14	9			ROOF HATCH FRM.

BILL OF MATERIAL

GALVANIZE AFTER FAB.

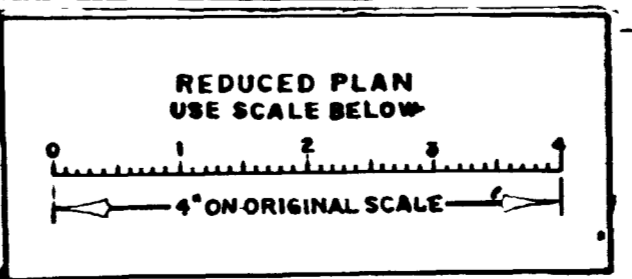
CONTRACTOR E M PENN CONST. CO.

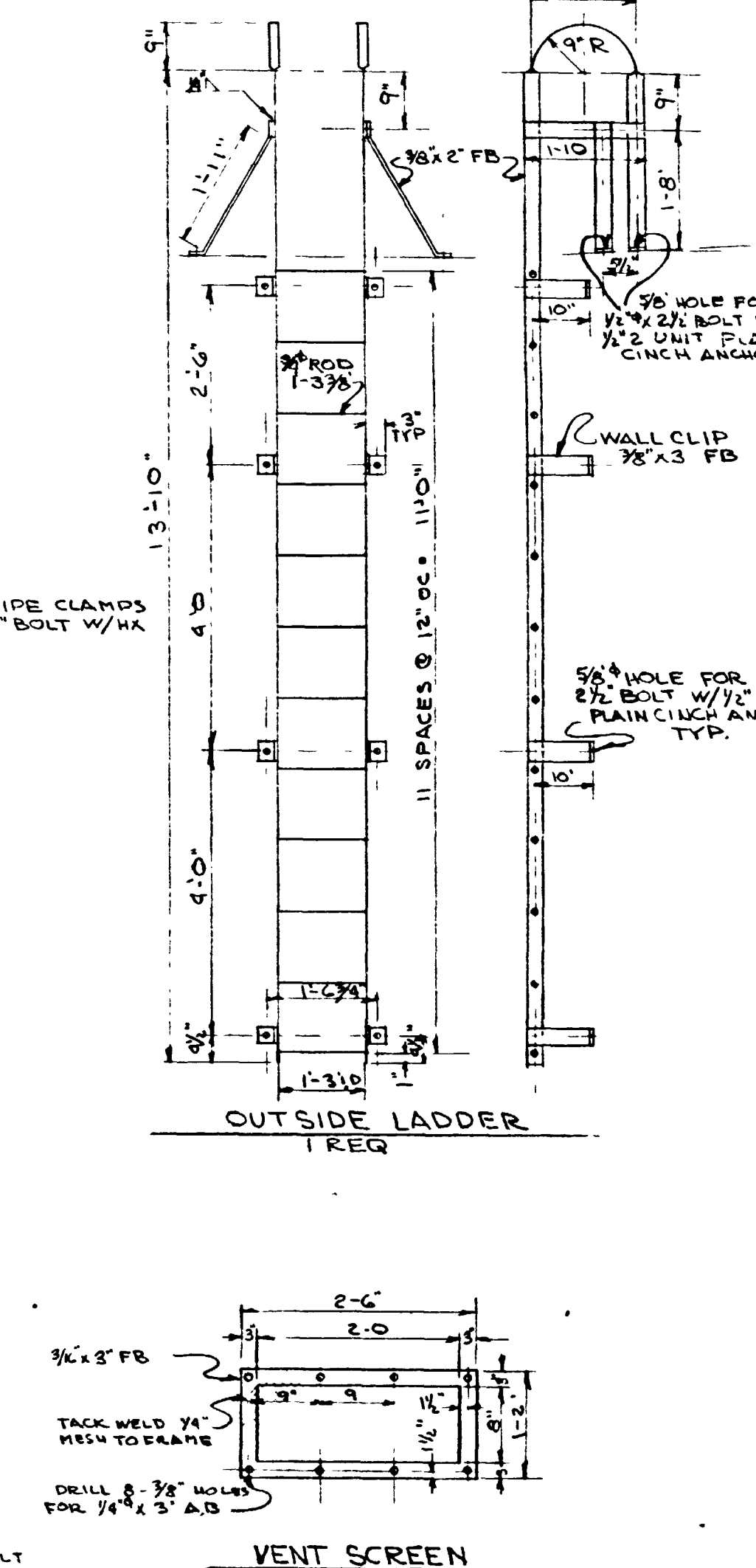
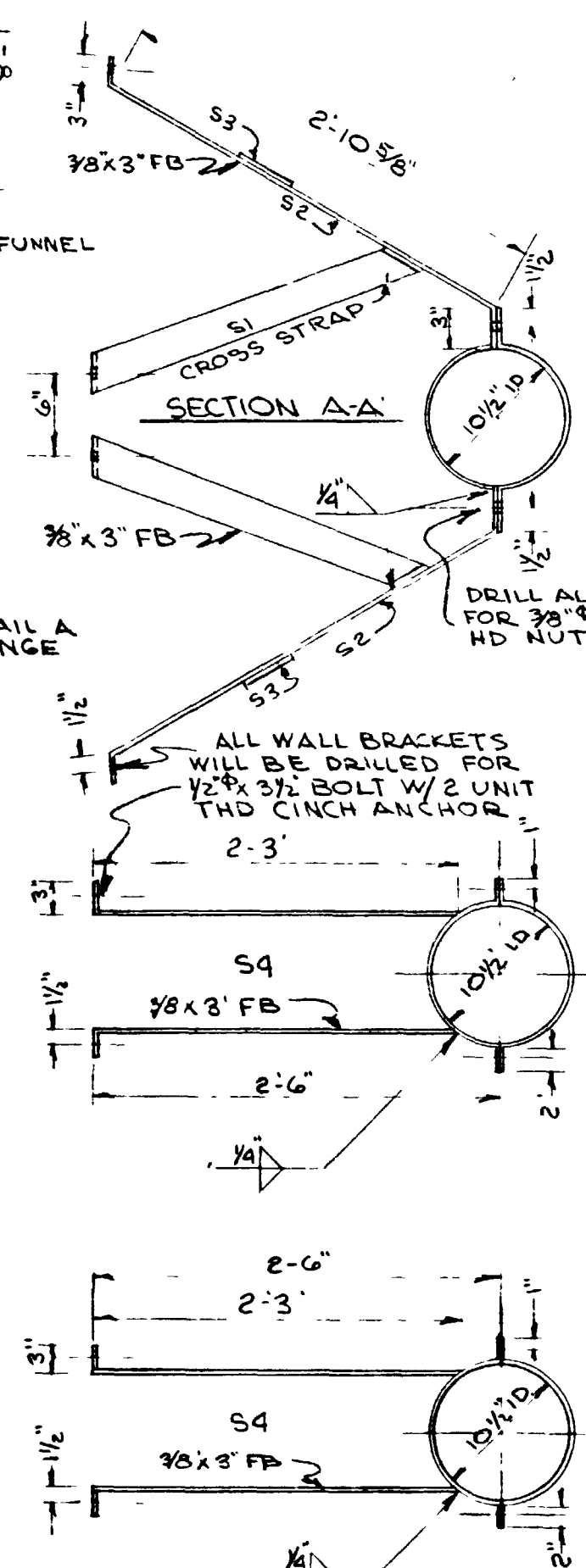
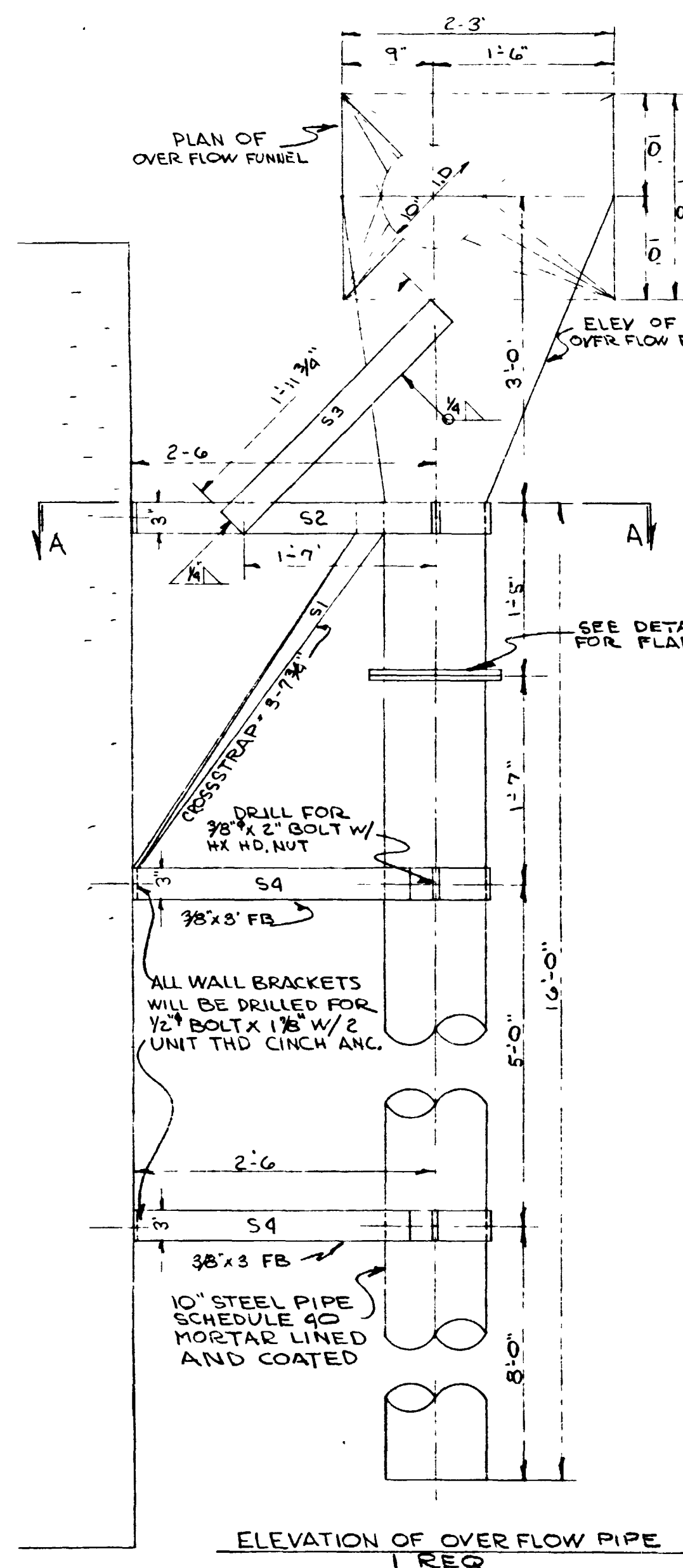
NO.	DESCRIPTION	DATE	BY	APP'D	DATE	BY	APP'D
1	DESIGNED						
2	DRAWN						
3	CHECKED						
4	APPROVED						

ALHAMBRA FOUNDRY CO-LTD
ALHAMBRA CALIFORNIA

SOLEDAD RESERVOIR
SAN DIEGO CALIF
MISC. FAB STL.

JOB NO. 41411-P
DATE 1-87
DRAWING NO. C-321





PART NO.	DESCRIPTION	QTY	UNIT	TOTAL QTY	REMARKS
	VENT SCREEN	2			
	1/4" x 3" A.B.			16	
	1/4" MESH WIRE				2'6" x 1'-2"
	3/16" x 3" FB			12	8 VENT SCREEN
	INSIDE LADDER	1			
	1/2" x 1 7/8" BOLT			12	2 UNIT THD CINCH
	3/4" ROD			23	7/8" LADDER RUNGS
	3/8" x 3" FB			13	4 WALL CLIPS
	3/8" x 2" FB			36	8 LADDER STRINGER
	OUTSIDE LADDER	1			
	1/2" x 2 1/2" BOLT W/ NUT			8	2 UNIT PLAIN CINCH
	3/4" ROD			15	7/8" LADDER RUNGS
	3/8" x 3" FB			9	4 WALL CLIPS
	3/8" x 2" FB			40	2 LADDER STRINGER
	OVER FLOW PIPE	1			
	3/8" x 2 1/2" BOLT			6	W/ WX HD NUT
	1/2" x 1 7/8" BOLT W/ NUT			6	2 UNIT THD CINCH
	3/8" x 2" BOLT			6	W/ WX HD NUT
	1/4" x 1'-2" x 2'-4"				PIPE FLANGE
	10" STD PIPE			16	0 OVER FLOW PIPE
	FB 3/8" x 3"			37	7/8" STRAPS & BRACKETS

BILL OF MATERIAL

GALVANIZE AFTER FABRICATION

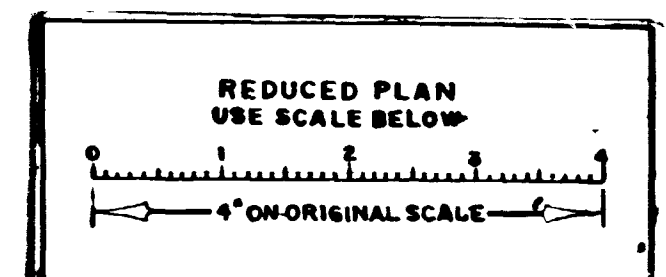
MICROFILMED

CONTRACTOR E. M. PENN CONST CO.

REVISION	DATE	BY	DESCRIPTION
1			

ALHAMBRA FOUNDRY CO LTD ALHAMBRA CA CALIFORNIA	SOLIDAD RESERVOIR SANDIEGO CALIF. MISC FAB STL.
--	--

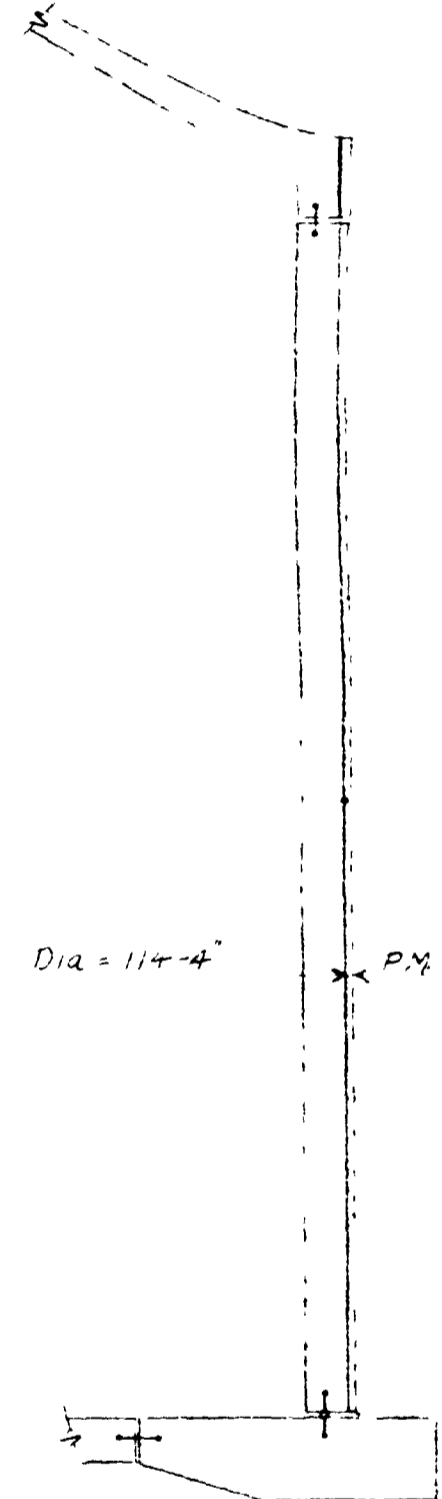
JOB NO. 41911 P
 SHEET NO. 2 - 2
 DRAWING NO. C-321-1
 FILE 7574C



CITY OF SAN DIEGO
 WATER DEPARTMENT
 This Drawing is approved subject to general requirements and corrections noted.
 O.K.

[Signature]
 ENGINEER

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
AA
AB



No of Turns Phase					Phase A	Phase B	Phase C	Phase D
Total	I	II	III	IV	Phase I	Phase II	Phase III	Phase IV
127	32	32	32	31				
10	6							
12	10							
14	14							
16	16							
18	18							
20	20							
22	22							
24	24							
26	26							
28	28							
30	30							
32	30	2						
34	30	4						
36	30	6						
38	30	8						
40	30	10						
42	30	12						
44	30	14						

	TOTALS				Phase	
	Total	I	II	III	IV	No of Turns
Dome Ring	127	32	32	32	31	No of Turns
Wall	492	436	56	-	-	No of Turns
Total	619	468	88	32	31	No of Turns

- ### SEQUENCE
- Phase I Apply First Layer of wire on Wall & Dome Ring
 - Phase A Apply 1/4" PM coat to wall & Dome Ring
 - Phase II Apply 2nd Layer of wire on lower 7 ft of wall & on Dome R.
 - Phase B Apply 1/2" PM coat - full ht. of wall & Apply 1/4" PM coat to Dome R.
 - Phase III Apply 3rd Layer of wire on Dome Ring
 - Phase C Apply 1/4" PM coat to Dome R
 - Phase IV Apply 4th Layer of wire on Dome Ring.
 - Phase D Apply 1/2" final PM coat to Dome R

BILL OF MATERIAL

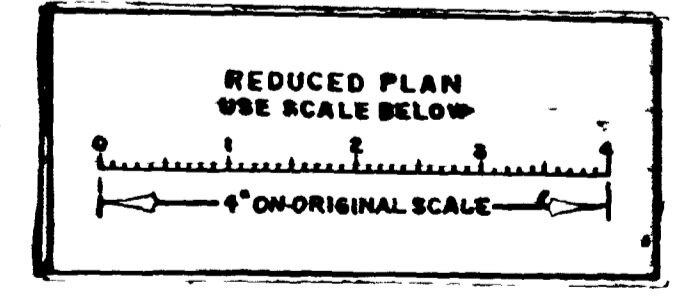
Quantity	Description
13000 Lbs	8 Ga MB Spring Wire
44 Ea	Stratline Splices
175 Ea	Guy Clamps
13 Ea	Dies

- ### General Notes
- Before prestressing Wire dia = .162"
 - After " " " = .141"
 - Initial Stress (wire) = 140,000 P.S.I.

MICROFILMED
FEB 5 1964

CITY OF SAN DIEGO
WATER DEPARTMENT
This Drawing is approved subject to contract requirements and corrections noted.
O.K.

M. J. ...
DATE
ENGINEER



NO.	DATE	DESCRIPTION
1	4/12/58	4" Dia. ... 1/2"

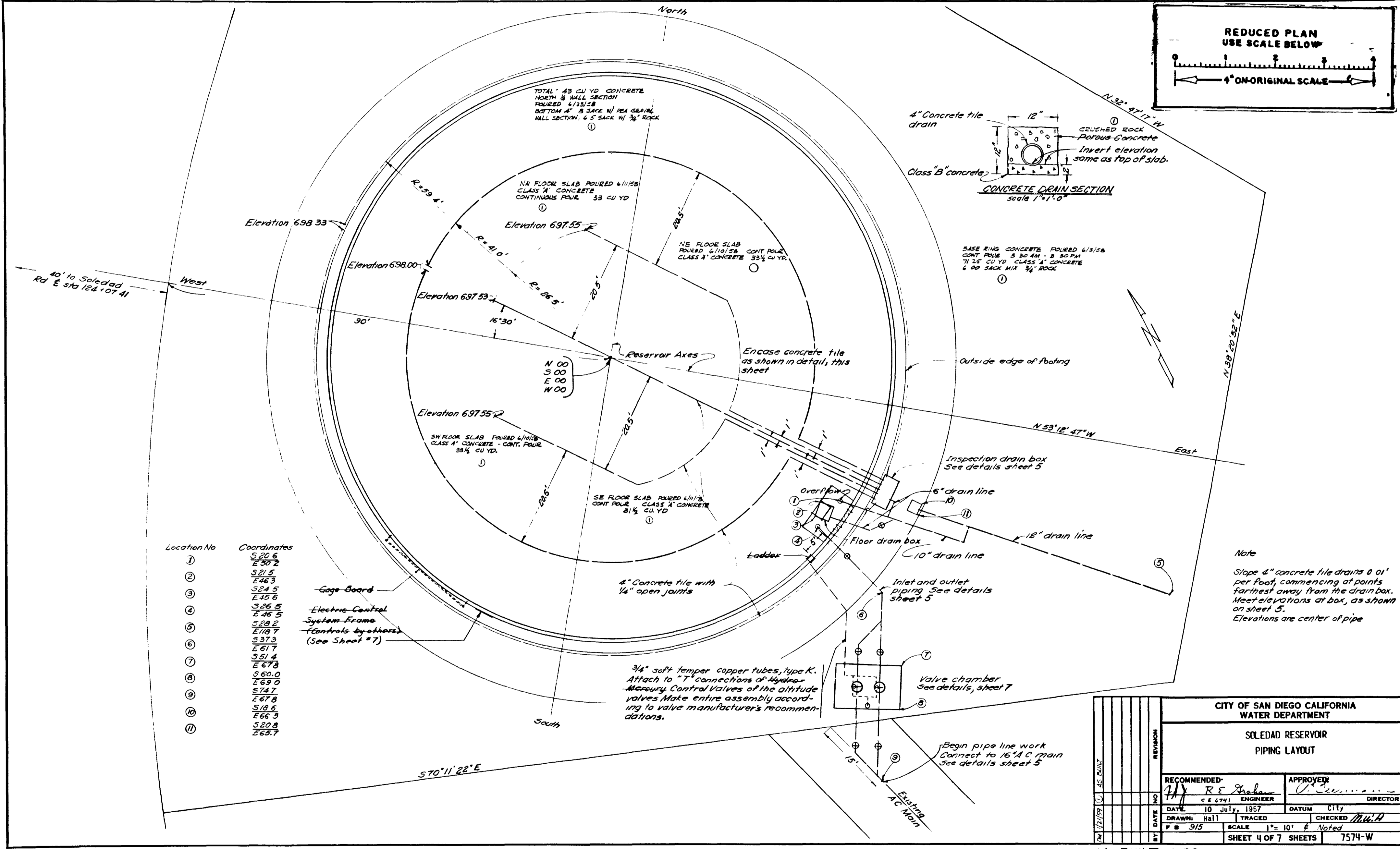
THIS DRAWING IS THE PROPERTY OF THE HERRICK IRON WORKS AND IS SUBJECT TO RETURN UPON DEMAND. IT CONTAINS FEATURES OF DESIGN WHICH ARE FULLY COVERED BY PATENTS, PATENTS PENDING AND COPYRIGHTS. IT IS LIMITED FOR USE ONLY IN CONNECTION WITH PROJECTS AND CONTRACTS OF THE LICENSEES OF THE PRELOAD COMPANY, INC. UNDER THE EXPRESS CONDITION THAT IT IS NOT TO BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTERESTS OF THE PRELOAD COMPANY, INC. OR HERRICK IRON WORKS.

Soledad Reservoir (1st M.G.)
San Diego, Calif.
Contractor: E. M. Penn Const Co.
Horizontal Prestress Schedule (Revised)

HERRICK IRON WORKS
SAN DIEGO, CALIF.
A DIVISION OF
THE PRELOAD COMPANY, INC. NO. 1, ST. LOUIS

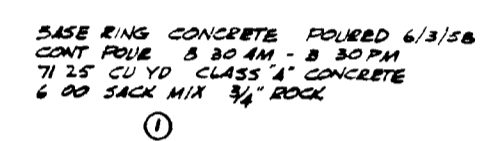
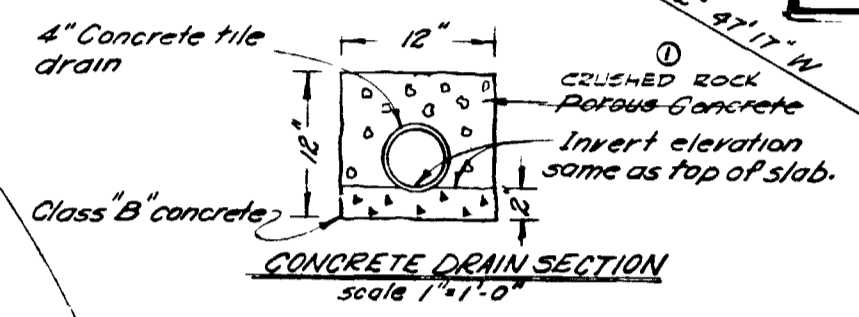
DRAWN: J.S.H. SCALE: NONE DATE: 7-58
CHECKED: [Signature] CONTRACT: PR 2371
APPROVED: [Signature] DRAWING NUMBER: PD-1

7574 C



**REDUCED PLAN
USE SCALE BELOW**

4" ON ORIGINAL SCALE



Location No	Coordinates
1	S 20.6 E 30.2
2	S 21.5 E 46.3
3	S 24.5 E 45.6
4	S 26.5 E 36.5
5	S 28.2 E 118.7
6	S 37.3 E 61.7
7	S 31.4 E 67.8
8	S 60.0 E 69.0
9	S 74.7 E 67.8
10	S 18.6 E 66.9
11	S 20.8 E 63.7

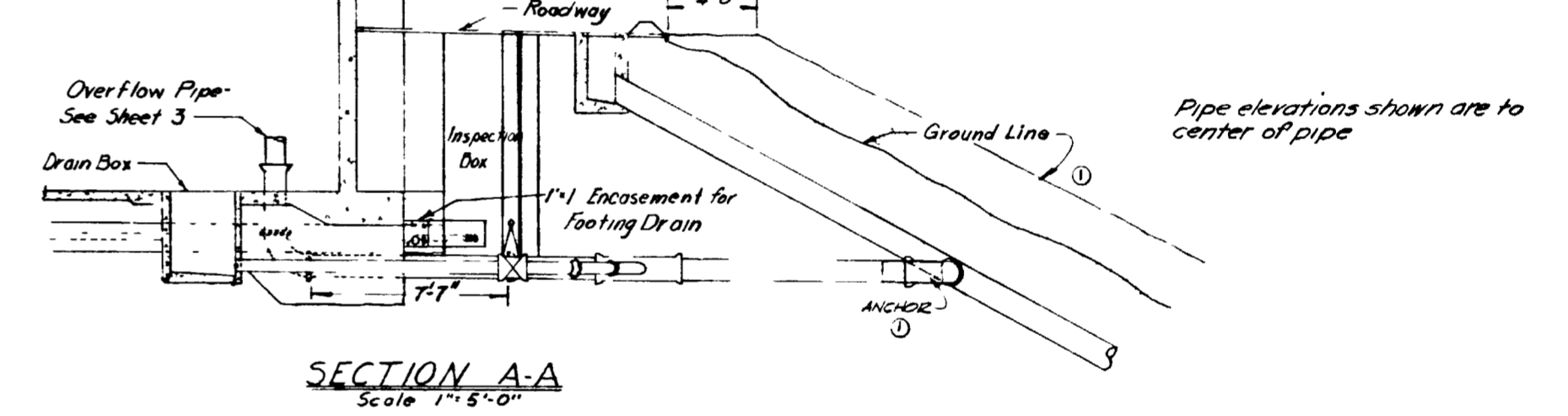
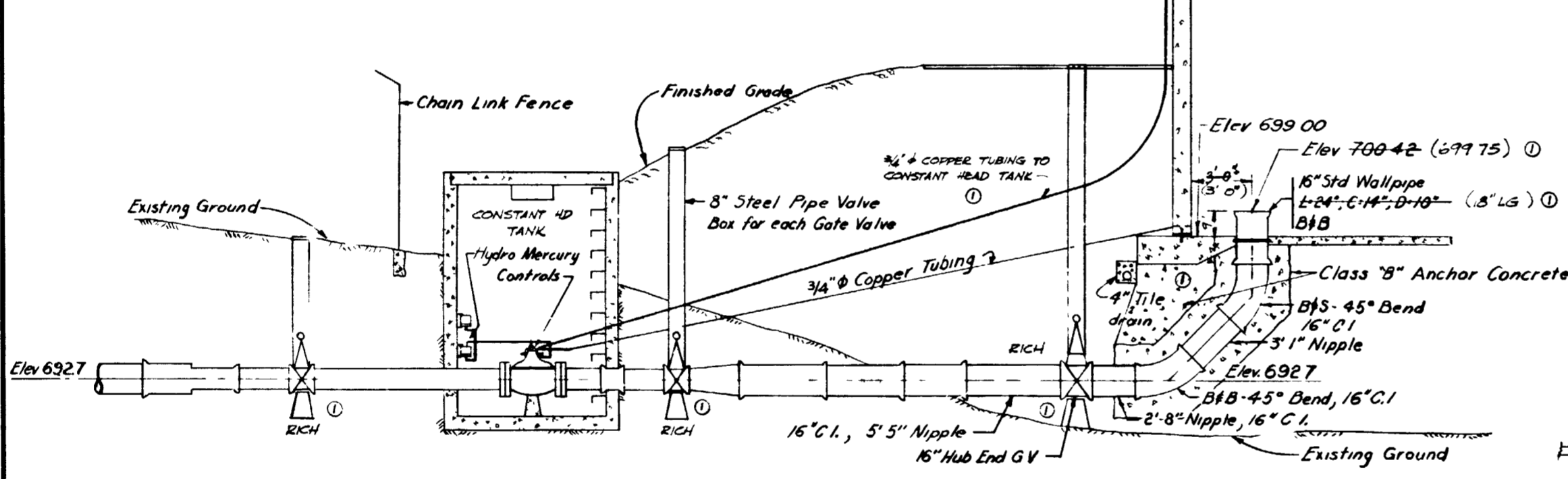
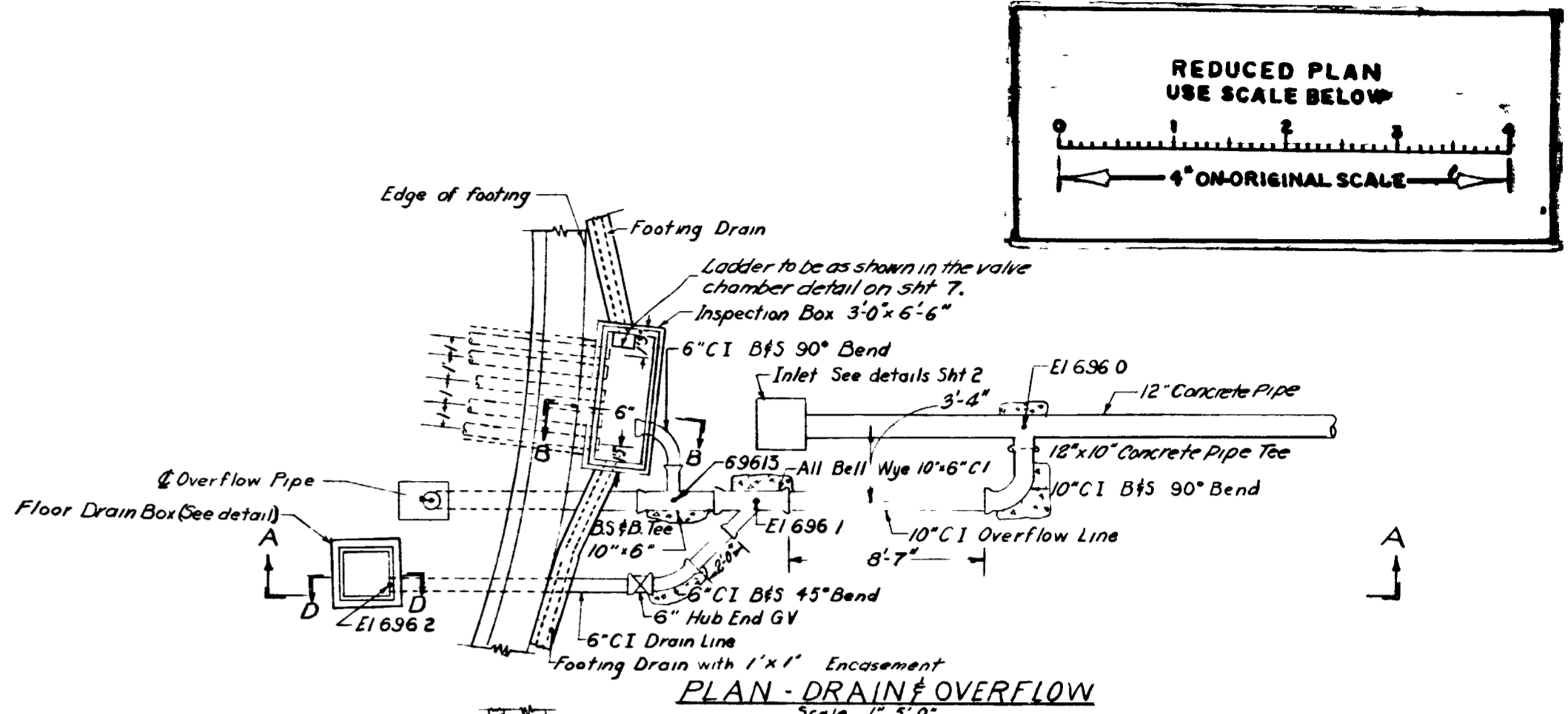
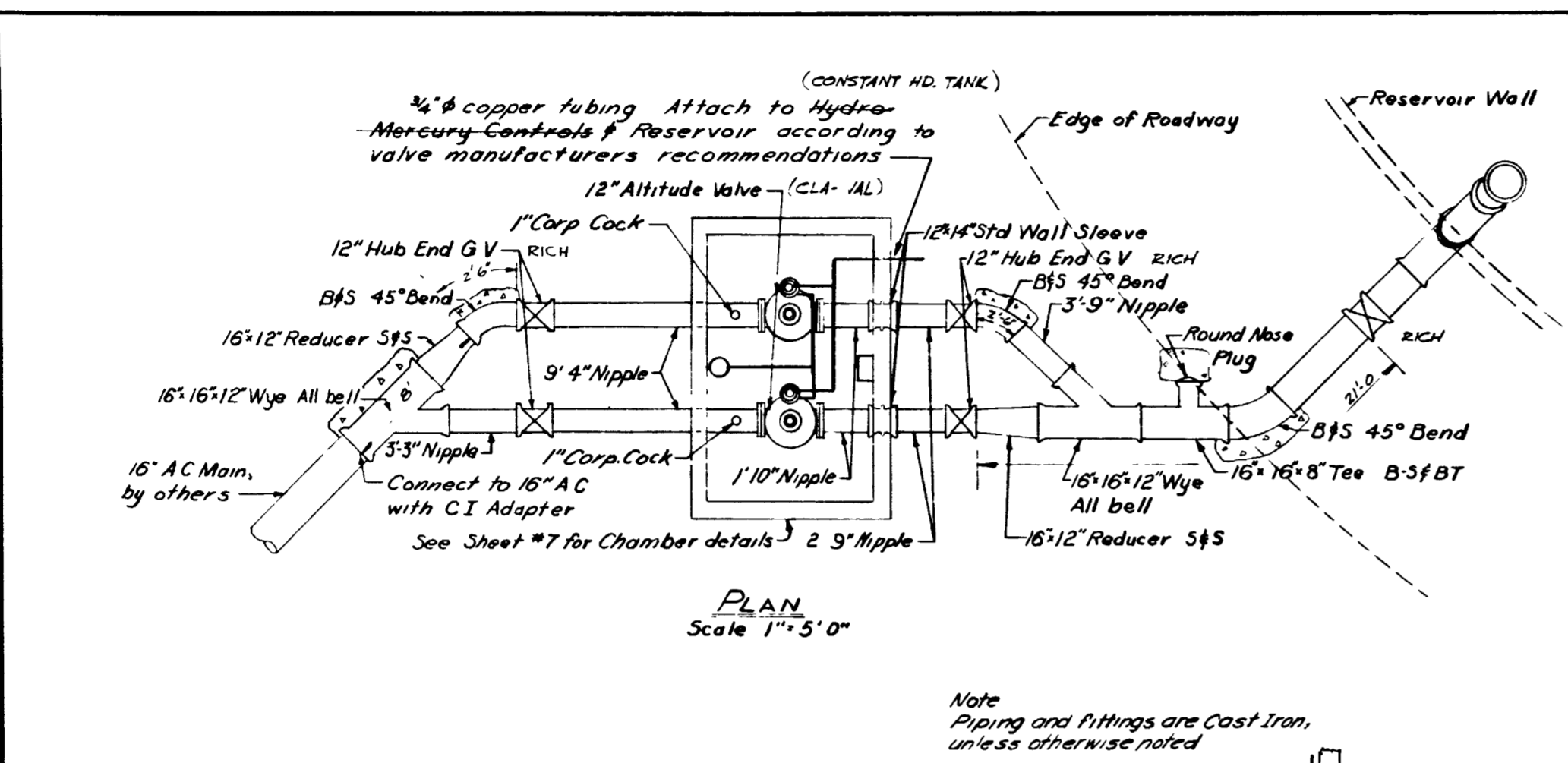
Gage Board
Electric Control System Frame
(Controls by others)
(See Sheet #7)

3/4" soft temper copper tubes, type K.
Attach to "T" connections of Hydramer Mercury Control Valves of the altitude valves. Make entire assembly according to valve manufacturer's recommendations.

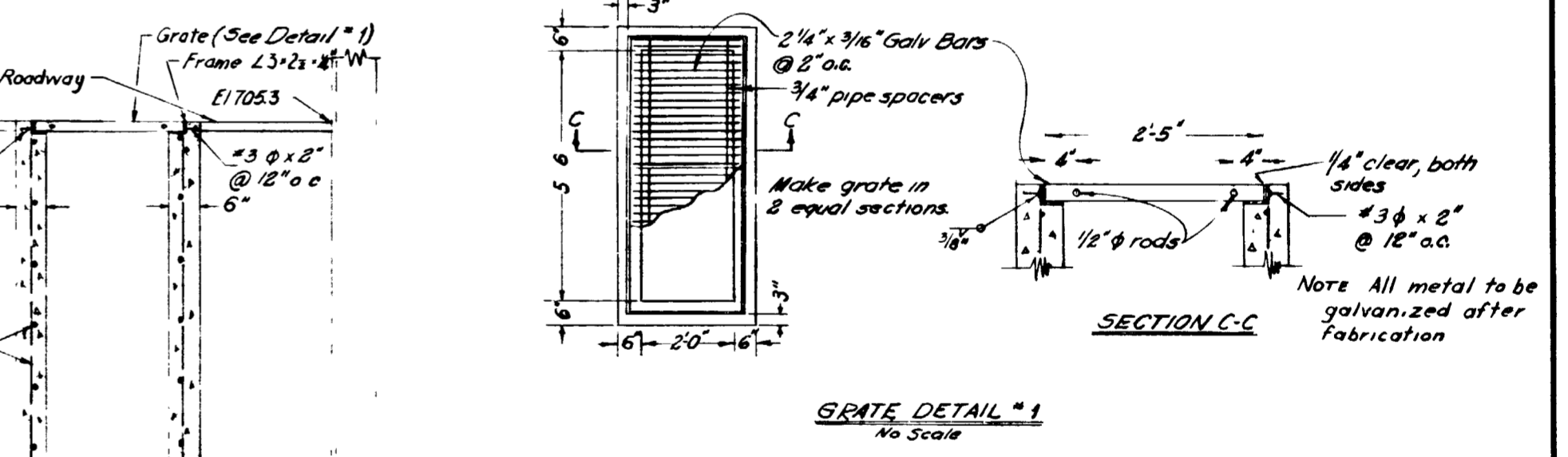
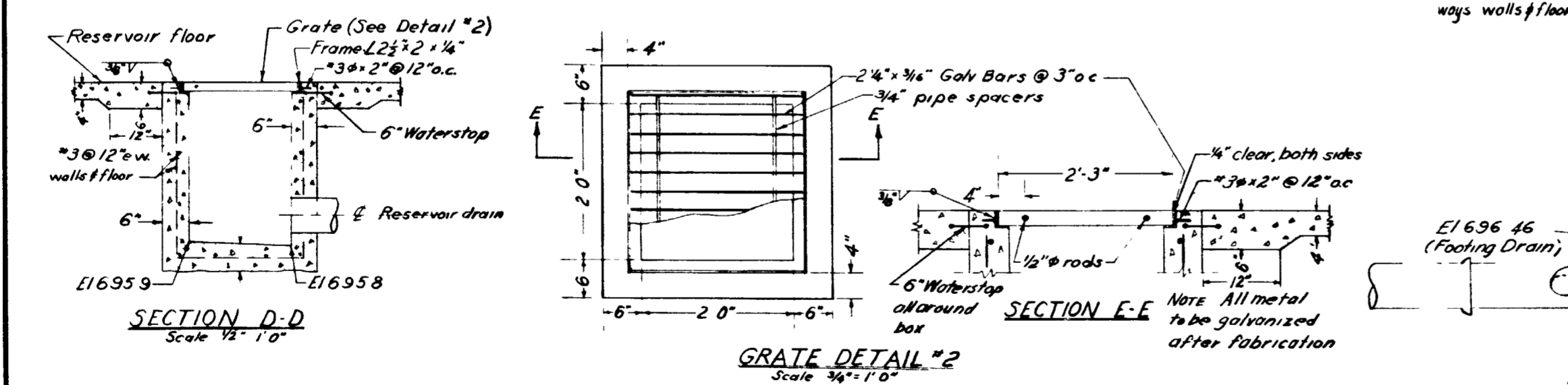
Note
Slope 4" concrete tile drains 0.01' per foot, commencing at points farthest away from the drain box. Meet elevations at box, as shown on sheet 5.
Elevations are center of pipe

CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT	
SOLEDAD RESERVOIR PIPING LAYOUT	
RECOMMENDED: <i>[Signature]</i> C. E. 6741 ENGINEER	APPROVED: <i>[Signature]</i> DIRECTOR
DATE: 10 July, 1957	DATUM: City
DRAWN: Hall	TRACED: [Signature]
P. B. 9/5	CHECKED: <i>[Signature]</i>
SCALE: 1" = 10' & Noted	SHEET 4 OF 7 SHEETS
7574-W	

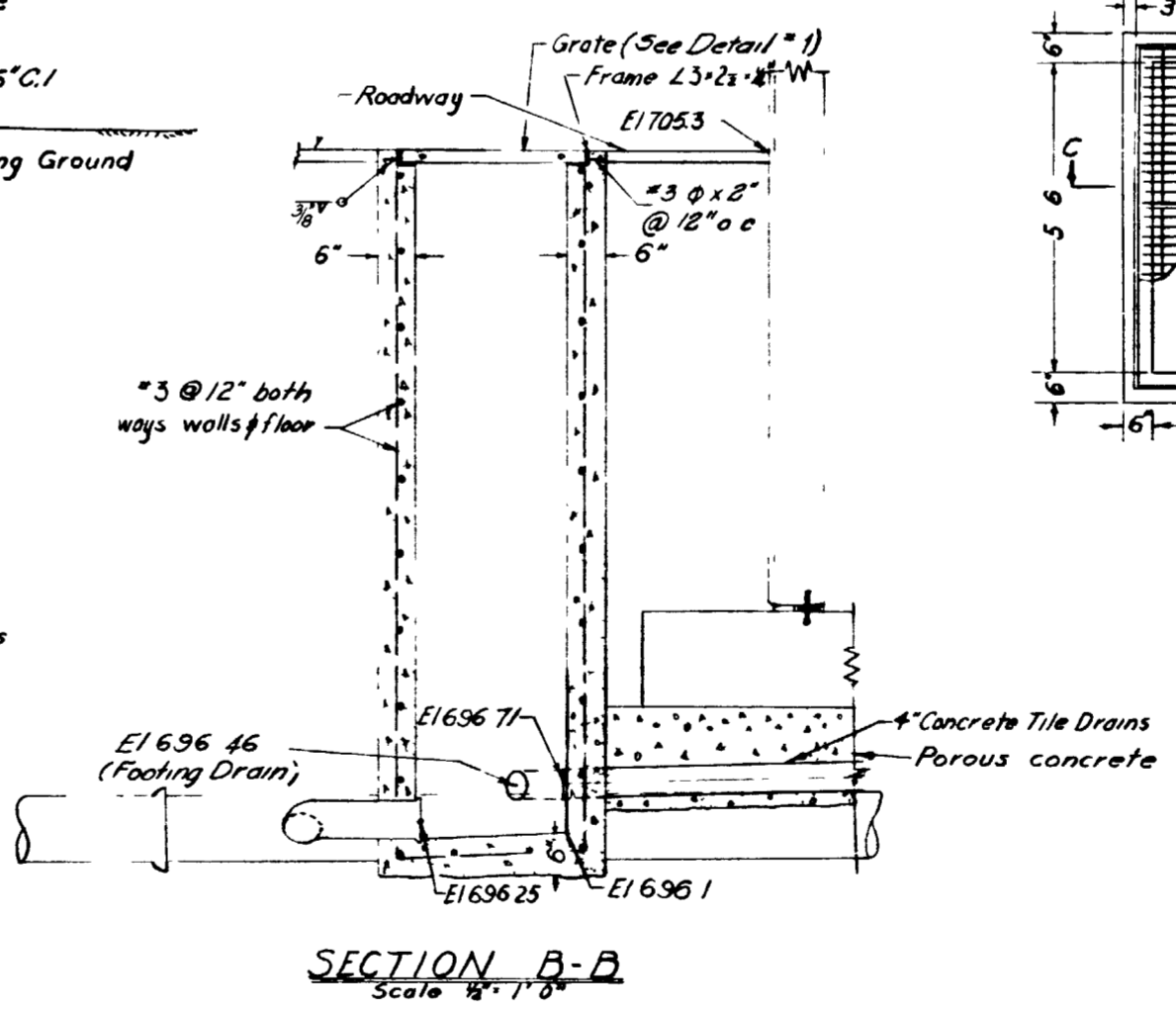
AS BUILT 1-59
MICROFILMED
JAN 24 1964



INLET-OUTLET PIPING DETAIL



FLOOR DRAIN BOX DETAILS



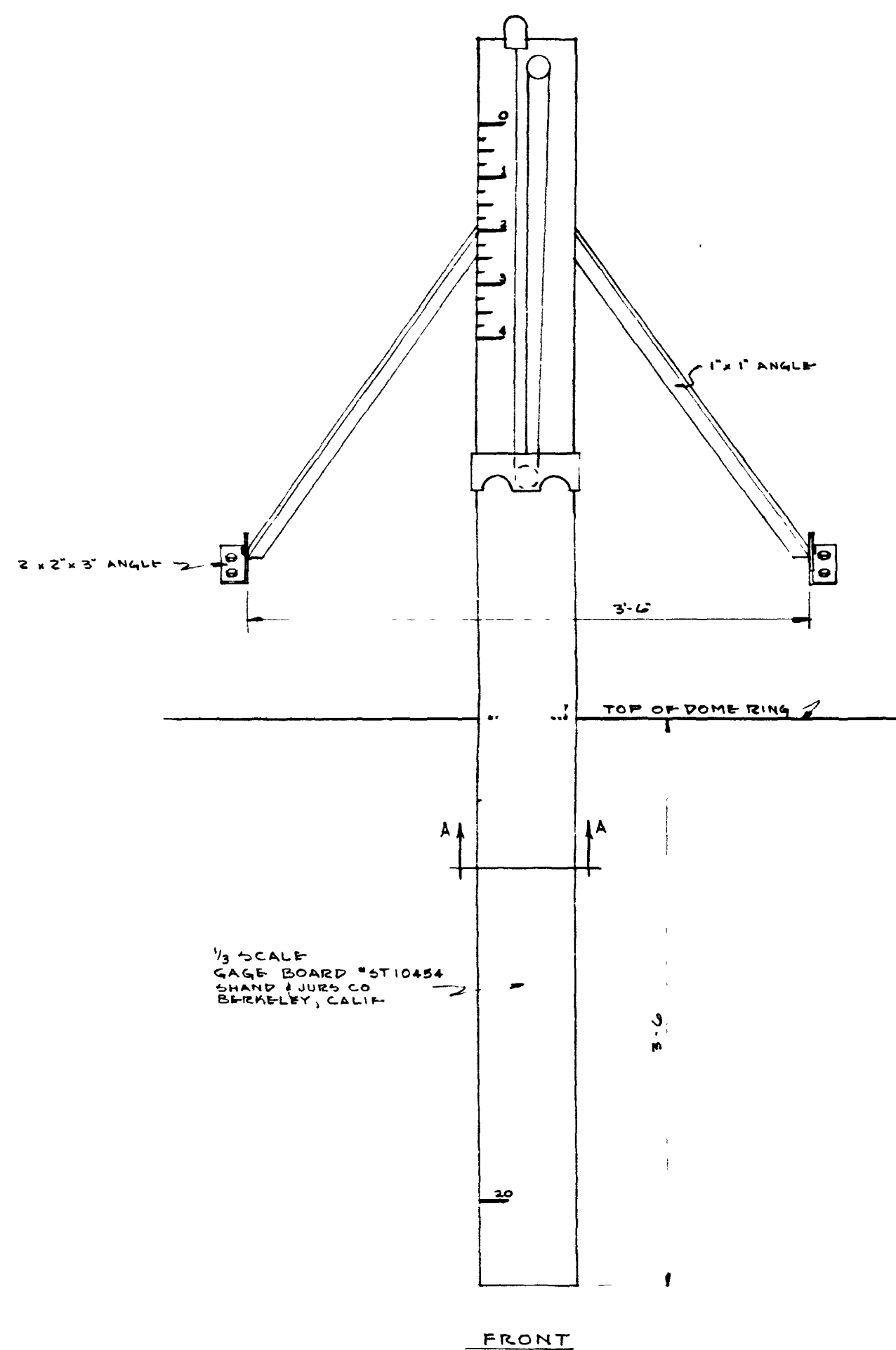
CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT	
SOLEDAD RESERVOIR PIPING DETAILS	
RECOMMENDED R. E. Thaler C.E. ENGINEER	APPROVED: [Signature] DIRECTOR
DATE: 2 July 1957	DATUM: City
DRAWN: Nagayzyna	TRACED: [Signature]
P. B. 9/5	SCALE: NOTED
SHEET 5 OF 7 SHEETS DWG NO 7574-W	

AS BUILT 1-59

MICROFILMED

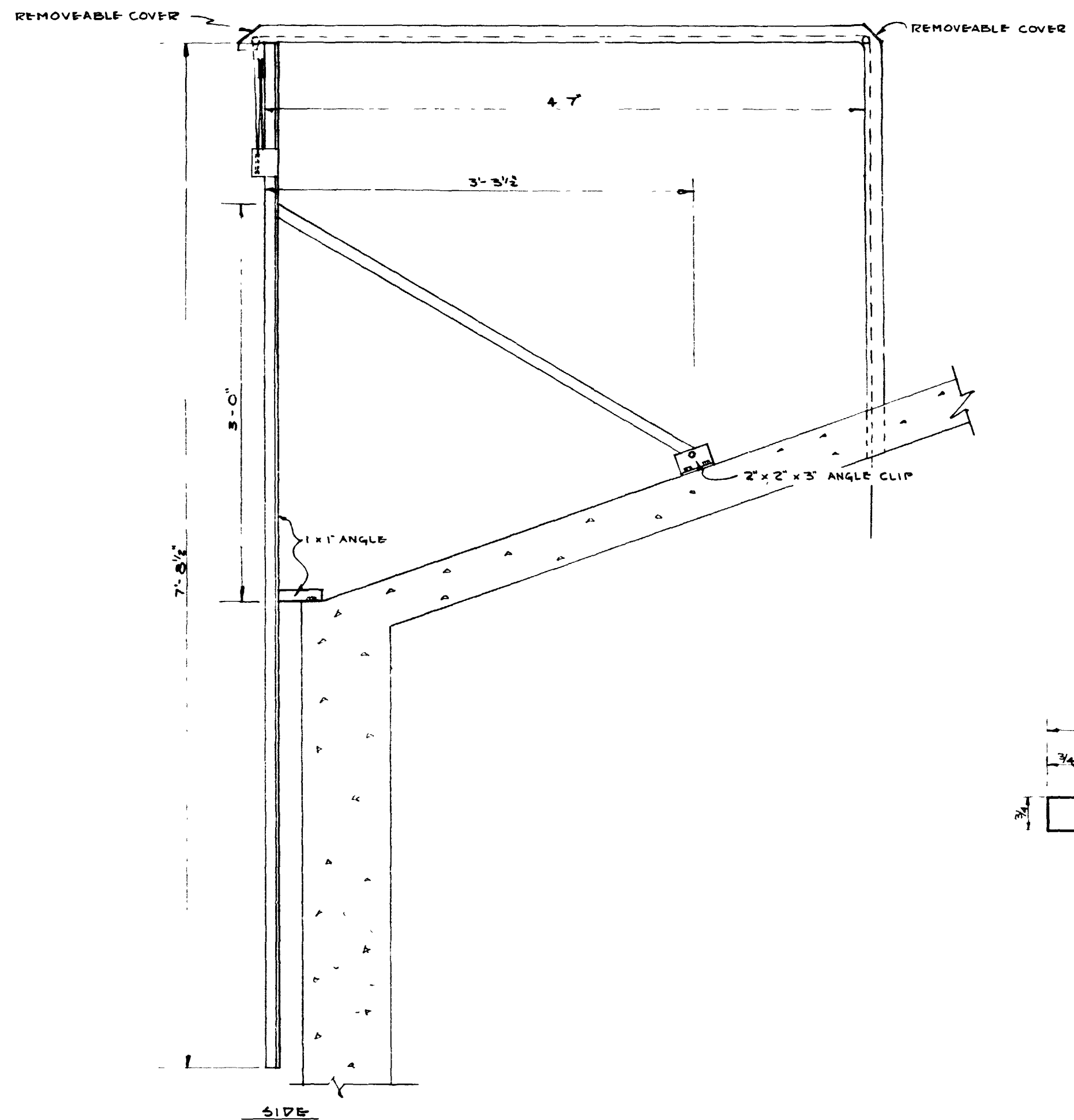
JAN 23 1964

1/2" - Thick Floor ground Drain Cap. and AA DD & EE
12/11/17

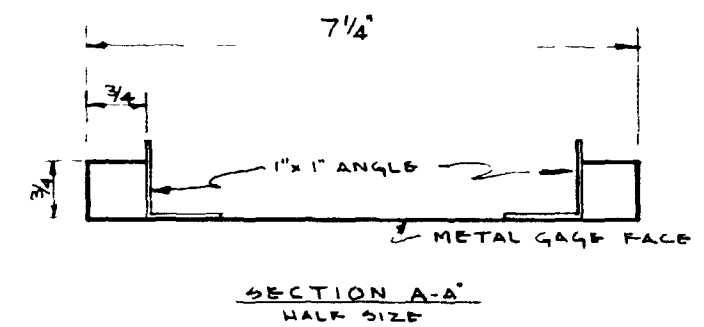


FRONT

SCALE 1/2" = 1'-0"

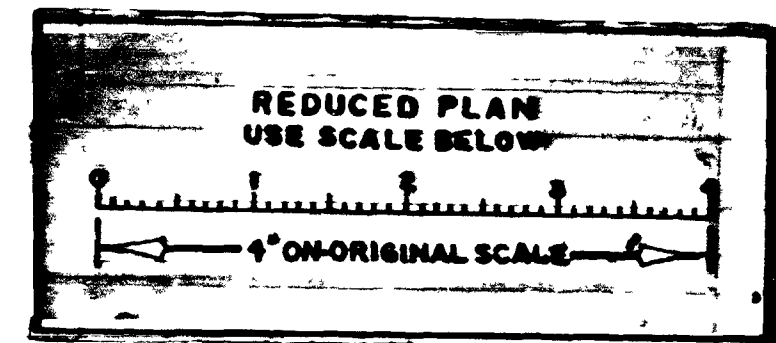


SIDE



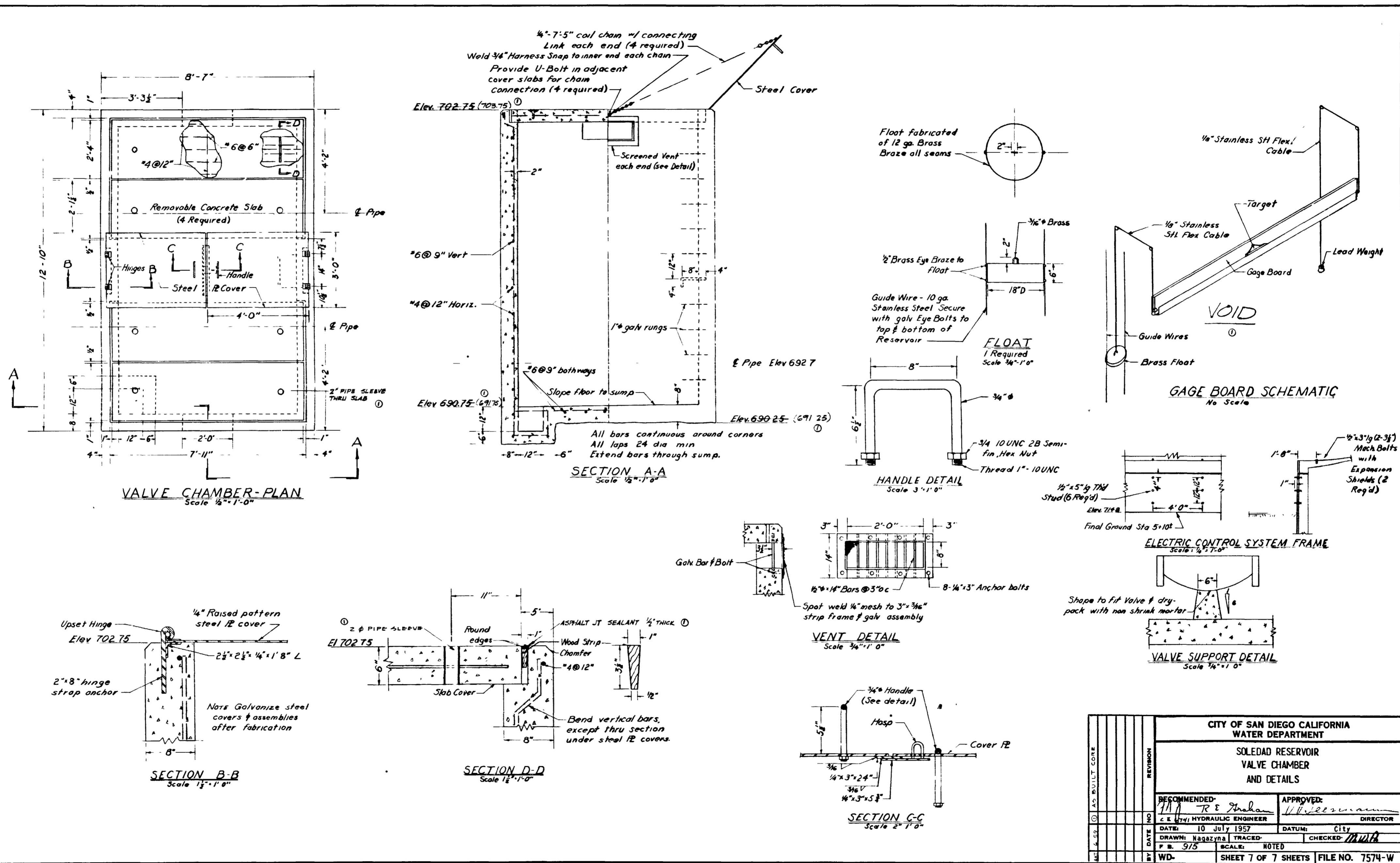
SECTION A-A
HALF SIZE

Note
See Technical File No 867

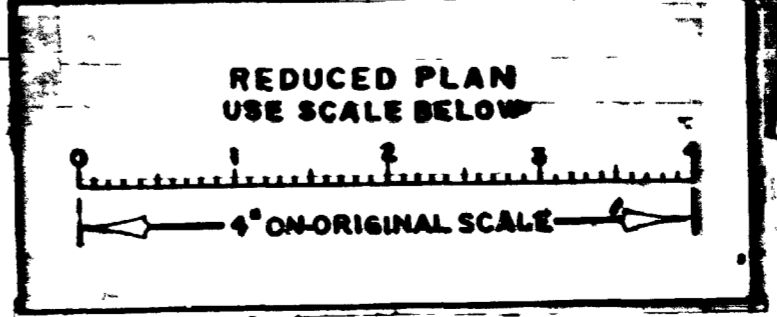


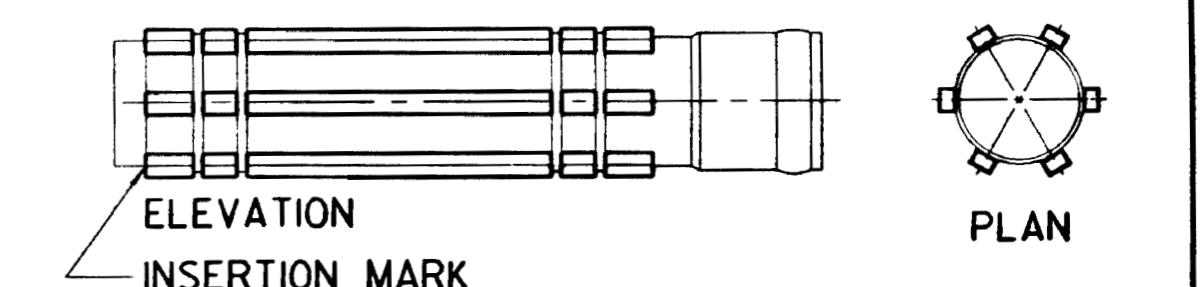
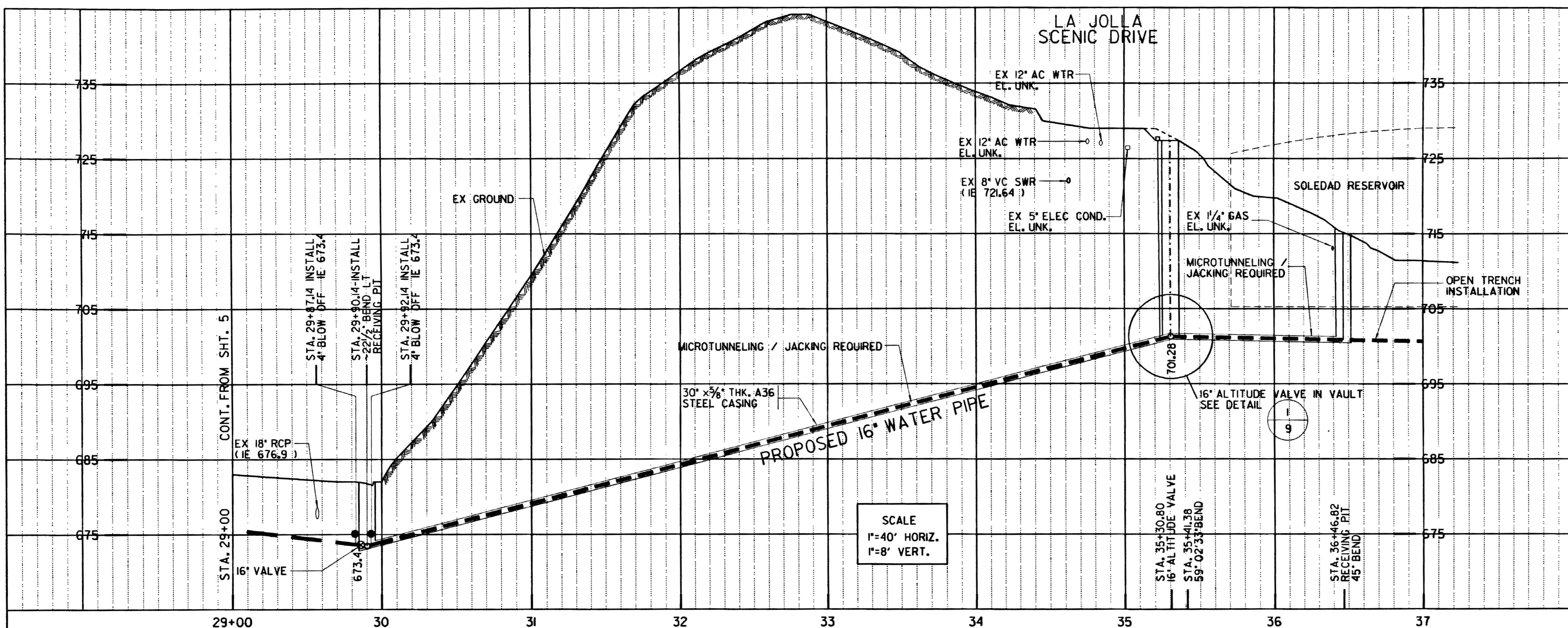
CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT			
SOLEDAD RESERVOIR GAGE BOARD			
RECOMMENDED:		APPROVED:	
HYDRAULIC ENGINEER		DIRECTOR	
DATE: 1-2-59	TRACED:	DATUM:	CHECKED:
DRAWN: AKT	SCALE: AS NOTED	FILE NO. 7574 W	
WD-	SHEET 6 OF 7 SHEETS	A5 BUILT 6-59	

MICROFILMED
JAN 29 1964



CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT			
SOLEDAD RESERVOIR VALVE CHAMBER AND DETAILS			
RECOMMENDED: C. S. W. HYDRAULIC ENGINEER	APPROVED: [Signature]	DIRECTOR	
DATE: 10 JUL 1957	DRAWN: Nagg2/yna	TRACED:	CHECKED: [Signature]
P. N. 975	SCALE: NOTED	FILE NO. 7574-W	
SHEET 7 OF 7 SHEETS			





- NOTES:**
- SKIDS SHALL BE USED ON EACH SECTION OF PIPE INSTALLED WITHIN THE CASING.
 - SKIDS MUST PROVIDE SUFFICIENT HEIGHT TO PERMIT CLEARANCE BETWEEN BELL AND CASING WALL.
 - ANY LUBRICANTS USED SHALL BE SUITABLE FOR USE WITH WATER APPLICATIONS AND BE NON-DAMAGING TO THE PIPE MATERIAL USED.
 - ANNULAR SPACE BETWEEN PIPE + CASING SHALL BE FILLED WITH CLEAN SAND AND GROUTED AT THE ENDS OF THE TUNNEL.

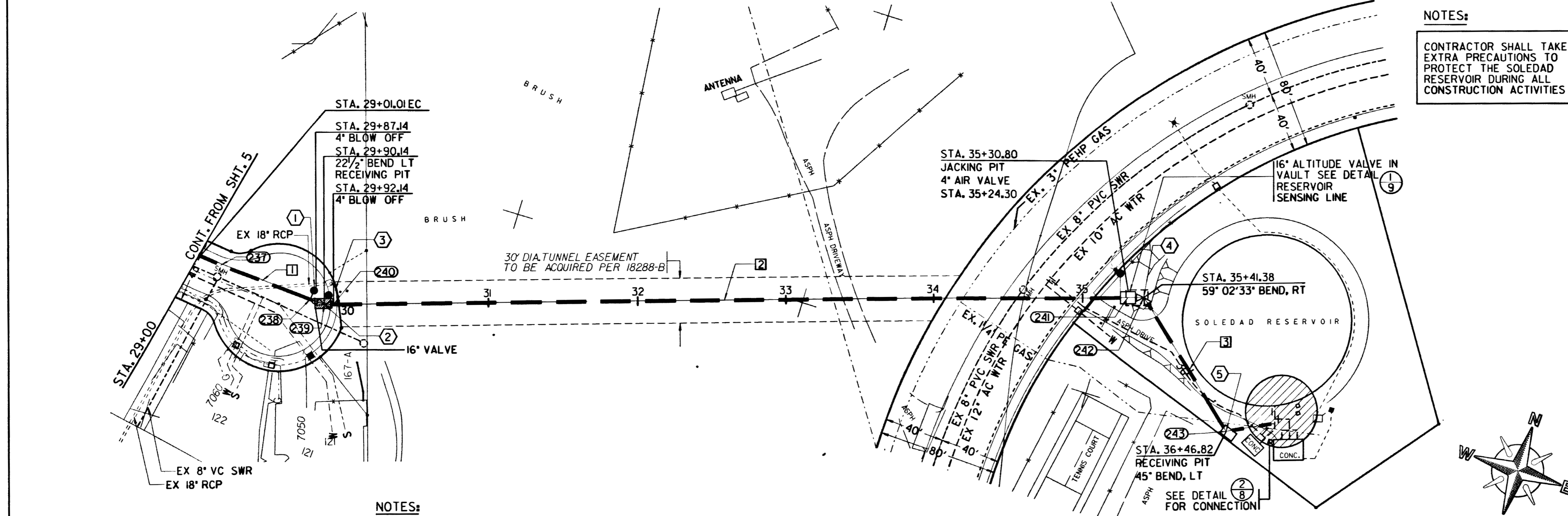
PROPOSED PIPE DATA TABLE

NO.	Δ/BEARING	RADIUS	LENGTH	CLASS
1	S85° 38' 44"E		89.08'	16" WATER MAIN
2	N72° 16' 19"E		560.47'	16" WATER MAIN
3	N48° 41' 08"W		105.44'	16" WATER MAIN

COORDINATE TABLE

NO.	NORTHING	EASTING	DESCRIPTION
237	245511.23	1692804.98	END OF CURVE
238	245504.66	1692890.81	4" BLOW OFF
239	245504.46	1692893.80	22 1/2" BEND
240	245505.07	1692895.71	4" BLOW OFF
241	245669.09	1693408.78	JACKING PIT
242	245672.32	1693418.87	59° 02' 33" BEND
243	245602.71	1693498.06	45° BEND

SCALE
1"=40' HORIZ.
1"=8' VERT.

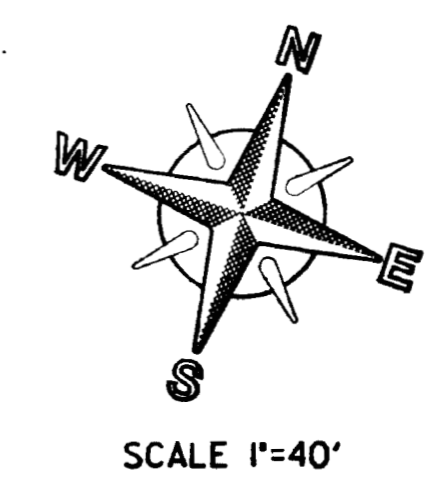


NOTES:
CONTRACTOR SHALL TAKE EXTRA PRECAUTIONS TO PROTECT THE SOLEDAD RESERVOIR DURING ALL CONSTRUCTION ACTIVITIES

- REFERENCE:**
- BENCH MARK:** NEBP SOLEDAD MTN. RD. & LA JOLLA SCENIC DR. EL. 692.269 M.S.L.
- FIELD NOTES:** FARNSWORTH, 244-1689, 2-25-93
W.O. 181341, SHT. 2 OF 35
7301-W, 13937-2-D, 14920-6-D, 16914-3-D
14899-7-D, 14899-13-D, 14920-6-D
14844-34-D
- WATER:** 13-256, 13-257
SEWER: 245-1693.5, 245-1692, 14920-8-D
STORM DRAIN: B-26
GAS: 2260
ELECTRIC: 13742-2-D, 14479-1-D, 14920-2-D, 14920-3-D, 14920-8-D
CABLE TV: B-26
TELEPHONE: 2260
IMPROVEMENTS: 13742-2-D, 14479-1-D, 14920-2-D, 14920-3-D, 14920-8-D
- WATER GATE BOOK:** B-II
SEWER GATE BOOK: B-II
100' SCALE: 244-1692
THOMAS BROS.: 44-B5

NOTE
THE LOCATION AND ELEVATION OF ALL UTILITY LINES ARE UNCONFIRMED. THE CONTRACTOR SHALL VERIFY LOCATION AND ELEVATIONS BEFORE COMMENCING CONSTRUCTION.

- NOTES:**
- BY CONTRACTOR FURNISH & INSTALL
STA. 29+87.14
1 - 4" BLOW OFF
 - BY CONTRACTOR FURNISH & INSTALL
STA. 29+90.14
1 - 22 1/2" BEND, LT (F)
1 - 16" VALVE, BK (F, MJ)
 - BY CONTRACTOR FURNISH & INSTALL
STA. 29+92.14
1 - 4" BLOW OFF
 - BY CONTRACTOR FURNISH & INSTALL
STA. 35+41.38
1 - 59° 02' 33" BEND, RT (F)
 - BY CONTRACTOR FURNISH & INSTALL
STA. 36+46.82
1 - 45° BEND, LT (F)



**GROUP JOB 506
CAMINITO DONOSO
LA JOLLA SCENIC DRIVE
STA. 29+00 TO SOLEDAD RESERVOIR**

CITY OF SAN DIEGO, CALIFORNIA
UTILITIES DEPARTMENT
SHEET 6 OF 9 SHEETS

WATER W.O. 181341
SEWER W.O.

ASSIST. UTILITIES DIRECTOR: [Signature] 4-4-95 DATE
DEPUTY DIRECTOR: [Signature]

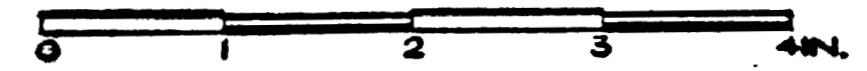
DESIGNER: [Signature] DESIGN ENGINEER

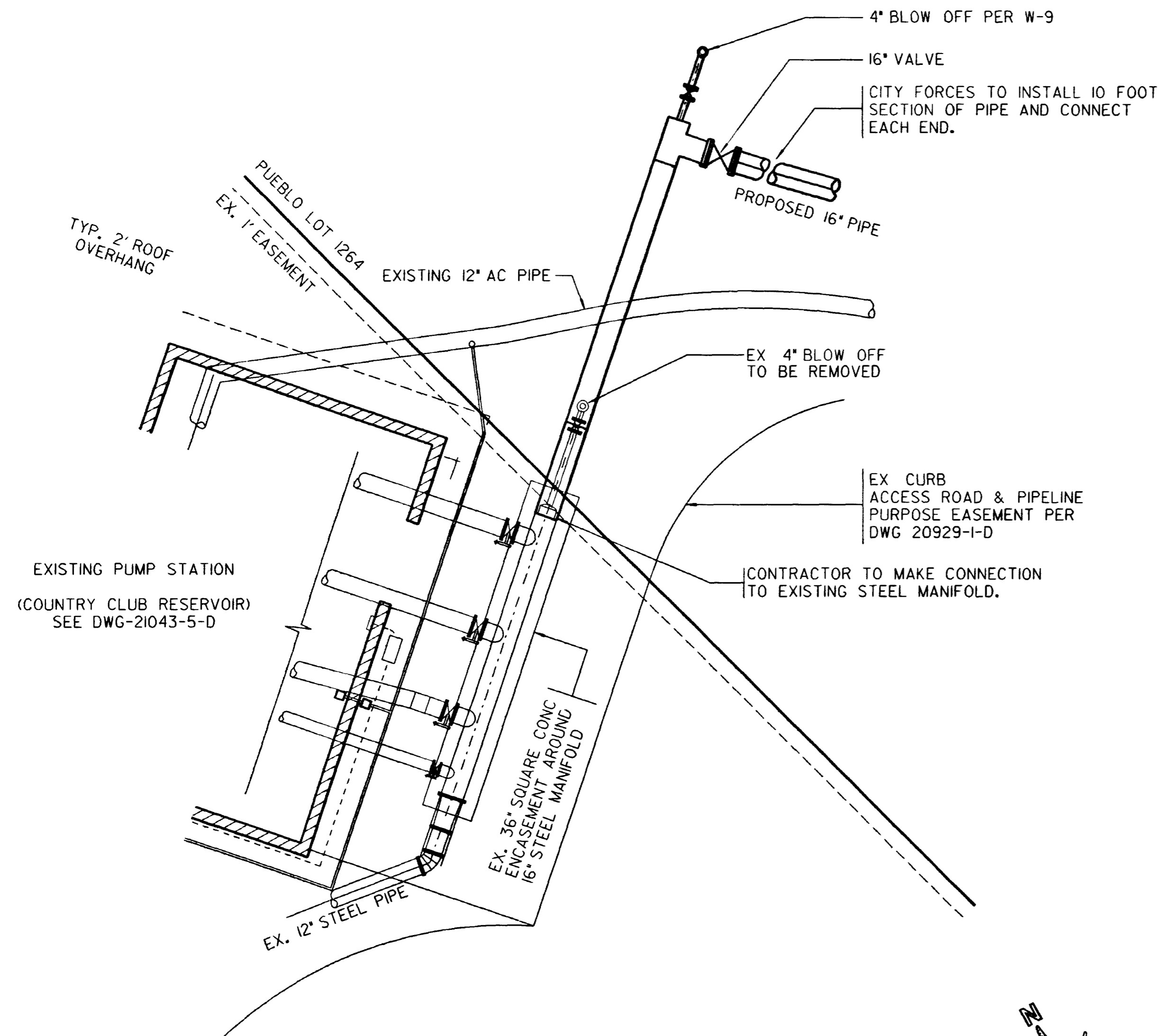
CONTROL CERTIFICATION
244-1692
LAMBERT COORDINATES

CONTRACTOR: _____ DATE STARTED: _____
INSPECTOR: _____ DATE COMPLETED: _____

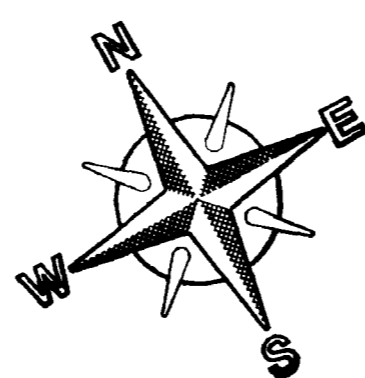
27622-6-D

FILED FROM THE ORIGINAL
BEST QUALITY OBTAINABLE



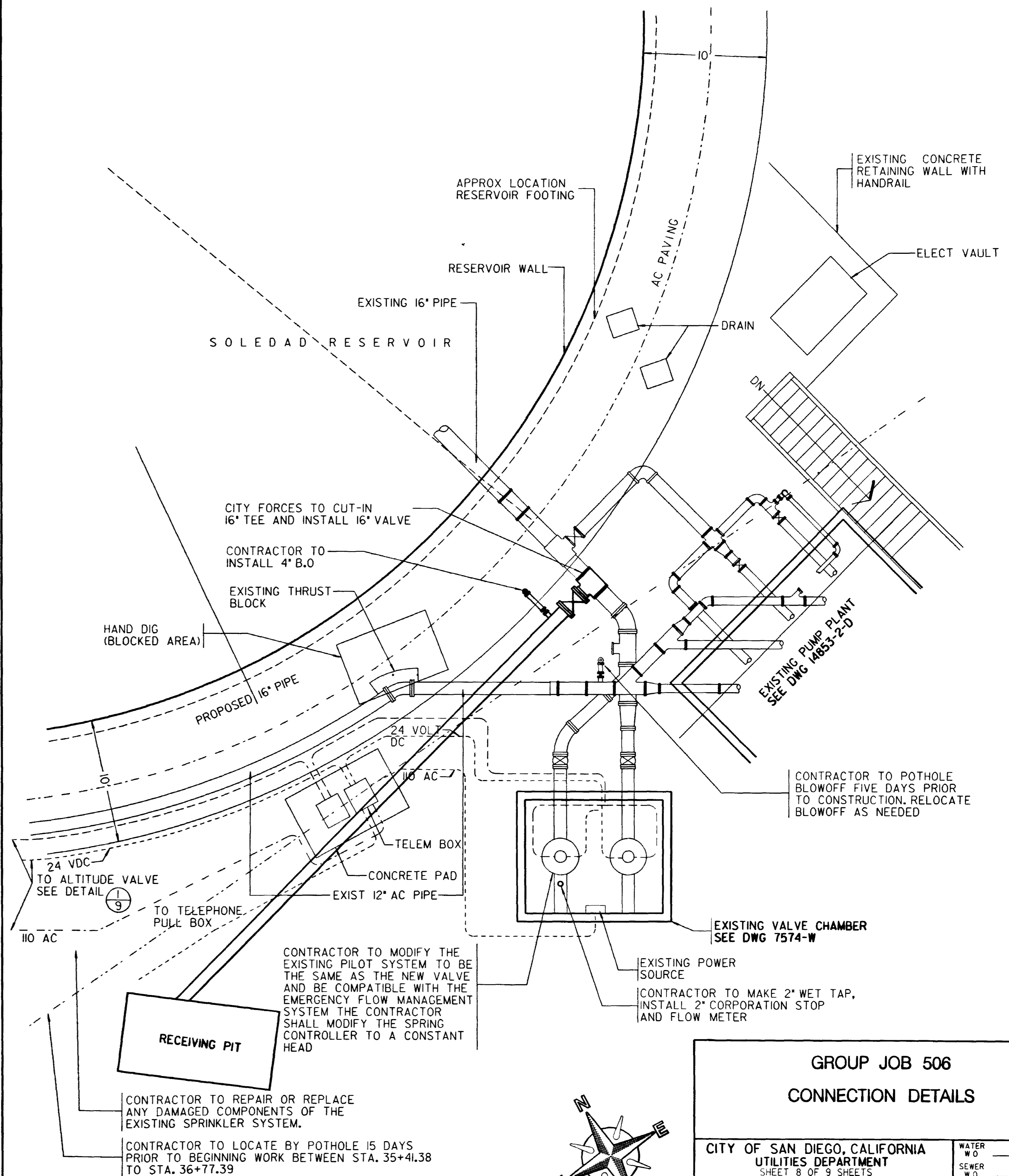


CONNECTION @ COUNTRY CLUB RESERVOIR ①
 COUNTRY CLUB RESERVOIR STA. 0+00 SCALE 3/16" = 1' 8

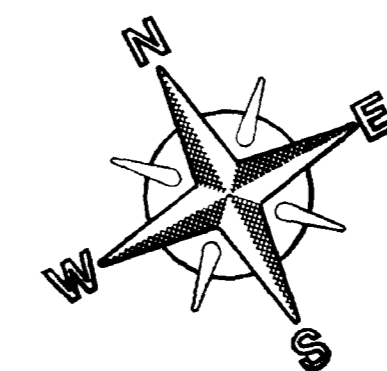


NOTE

THE LOCATION AND ELEVATION OF ALL UTILITY LINES ARE UNCONFIRMED THE CONTRACTOR SHALL VERIFY LOCATION AND ELEVATIONS BEFORE COMMENCING CONSTRUCTION



CONNECTION @ SOLEDAD RESERVOIR ②
 SOLEDAD RESERVOIR STA. 36+00 SCALE 3/16" = 1' 8



GROUP JOB 506			
CONNECTION DETAILS			
CITY OF SAN DIEGO, CALIFORNIA UTILITIES DEPARTMENT SHEET 8 OF 9 SHEETS			WATER W/O 181341 SEWER W/O
ASSIST UTILITIES DIRECTOR	DATE	4-4-95	DEPUTY DIRECTOR
DESCRIPTION	BY	APPROVED	DATE
ORIGINAL	TM/AB	4-3-95	4-14-95
	CJP		4-14-95
			CONTROL CERTIFICATION
			SEE EACH SHEET LAMBERT COORDINATES
CONTRACTOR	DATE STARTED		
INSPECTOR	DATE COMPLETED		27622-8-D

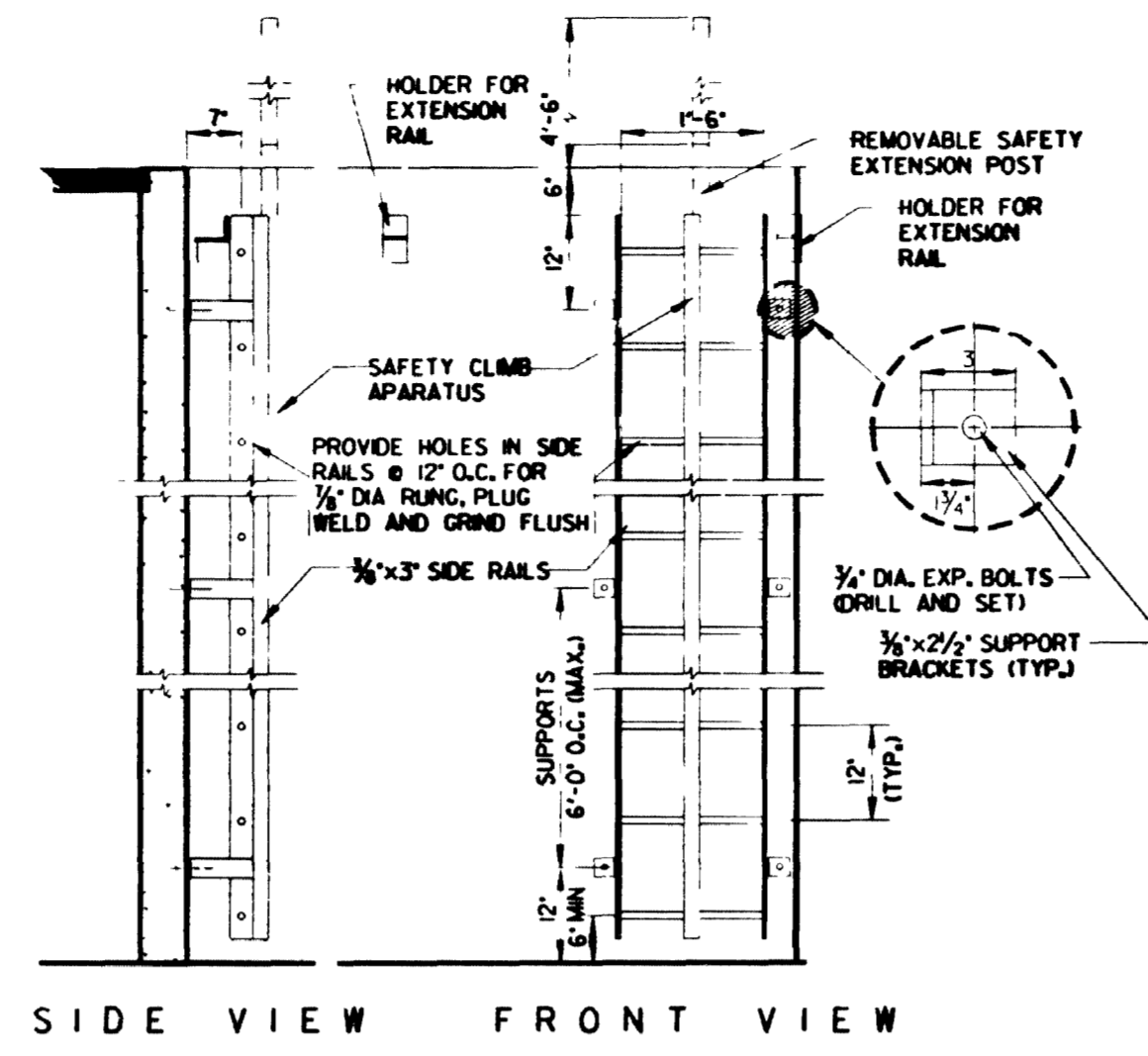
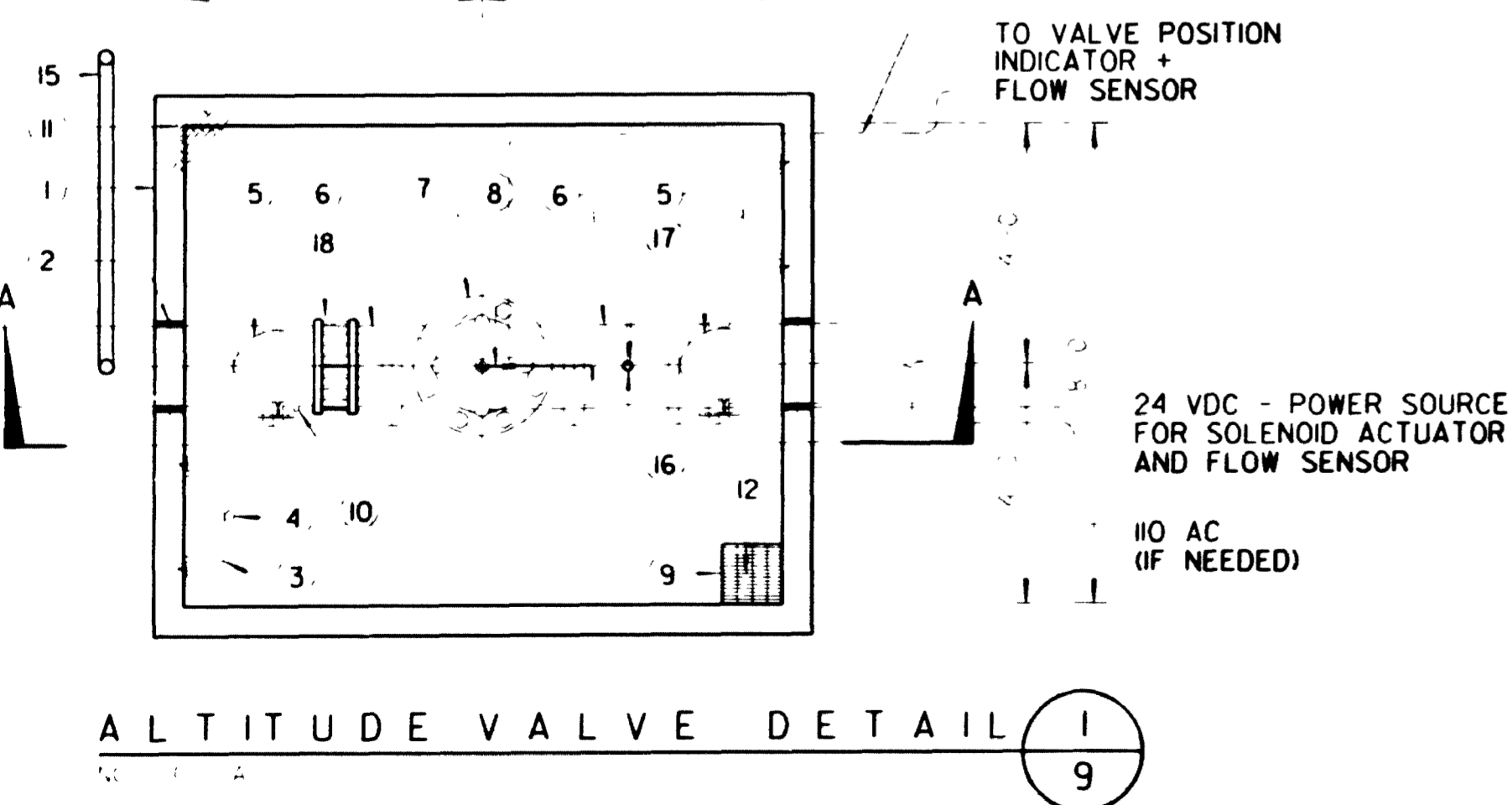
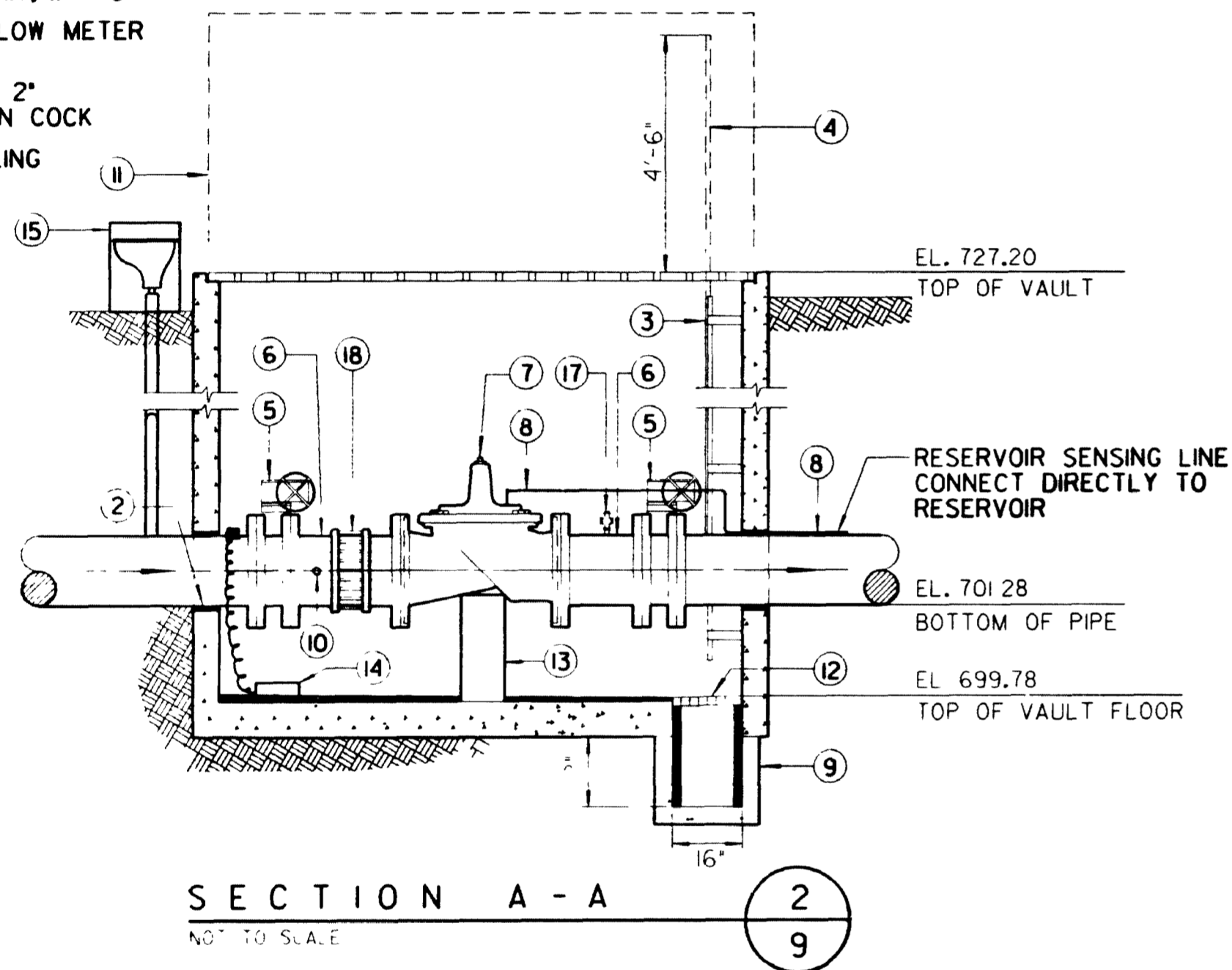
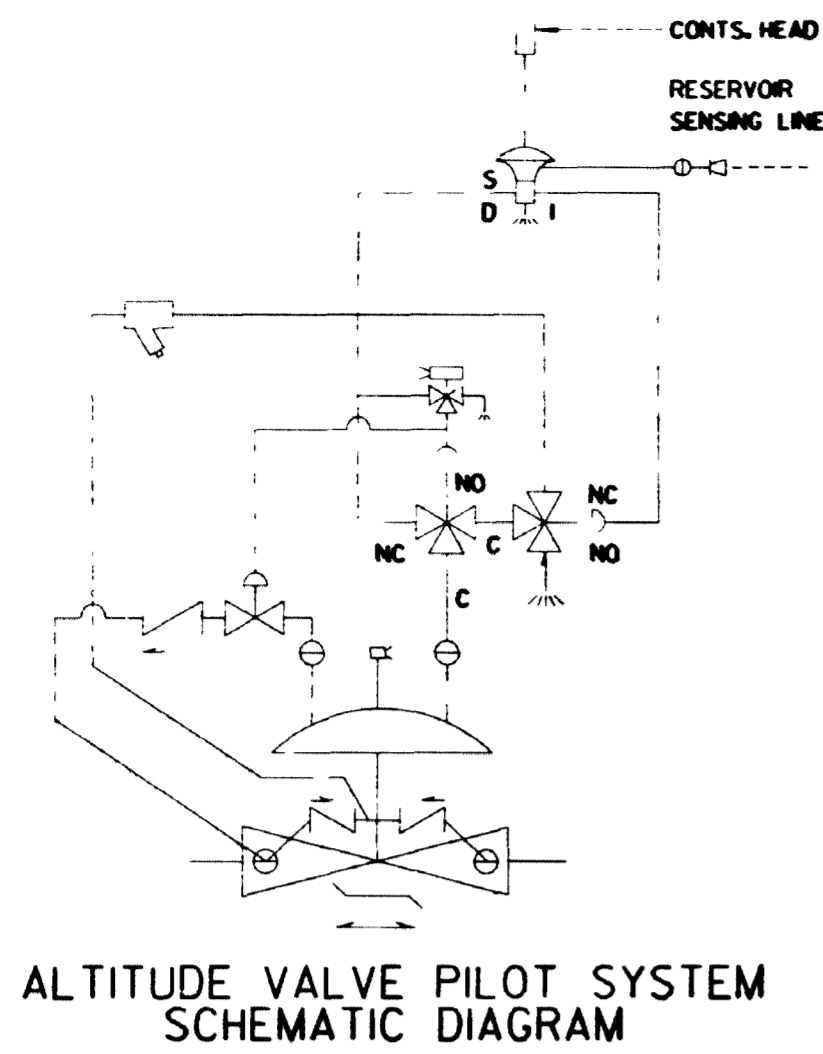
FILMED FROM THE ORIGINAL
BEST QUALITY OBTAINABLE



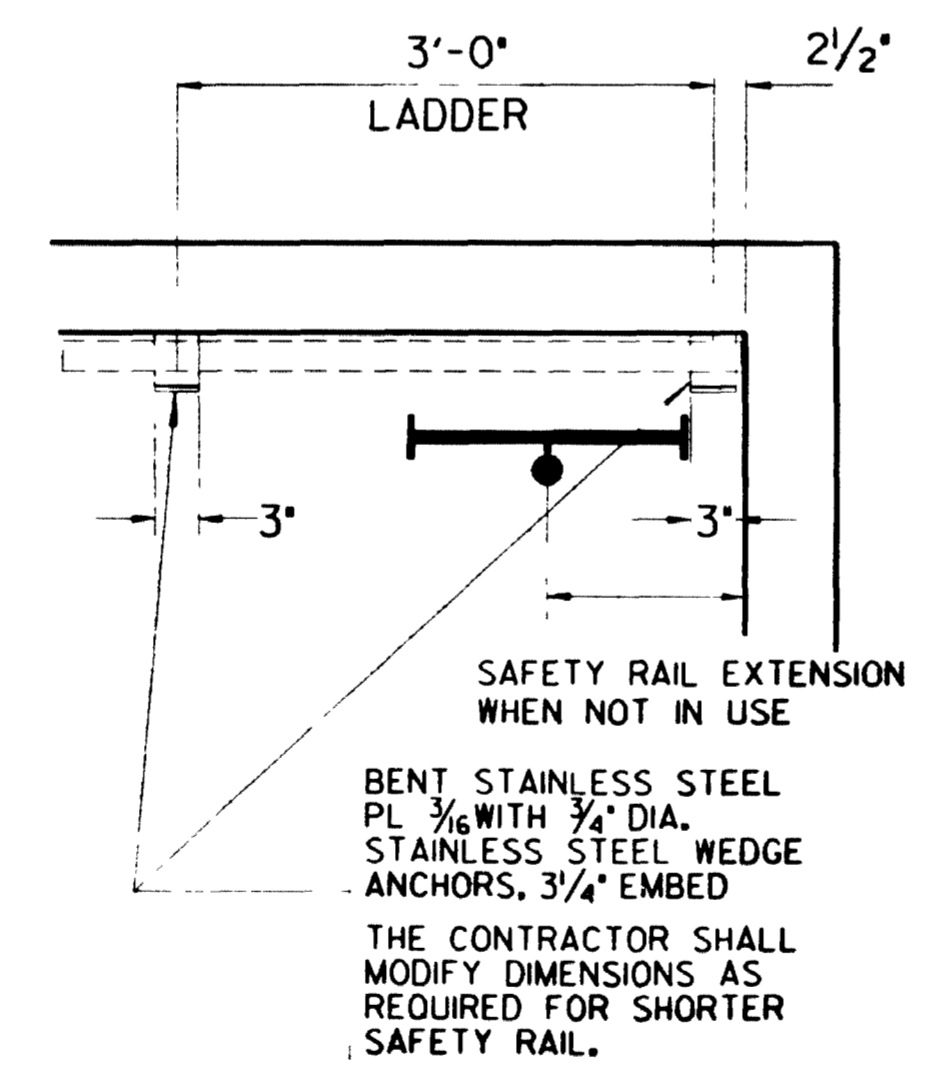
CONNECTION DETAILS

NOTES

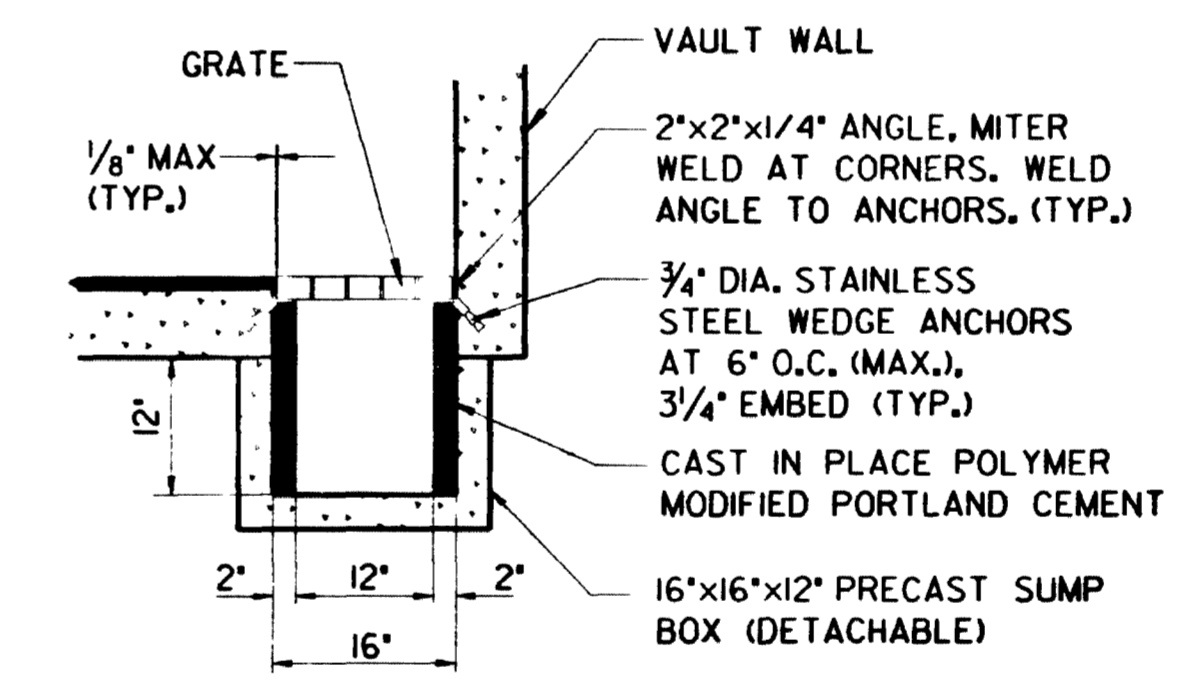
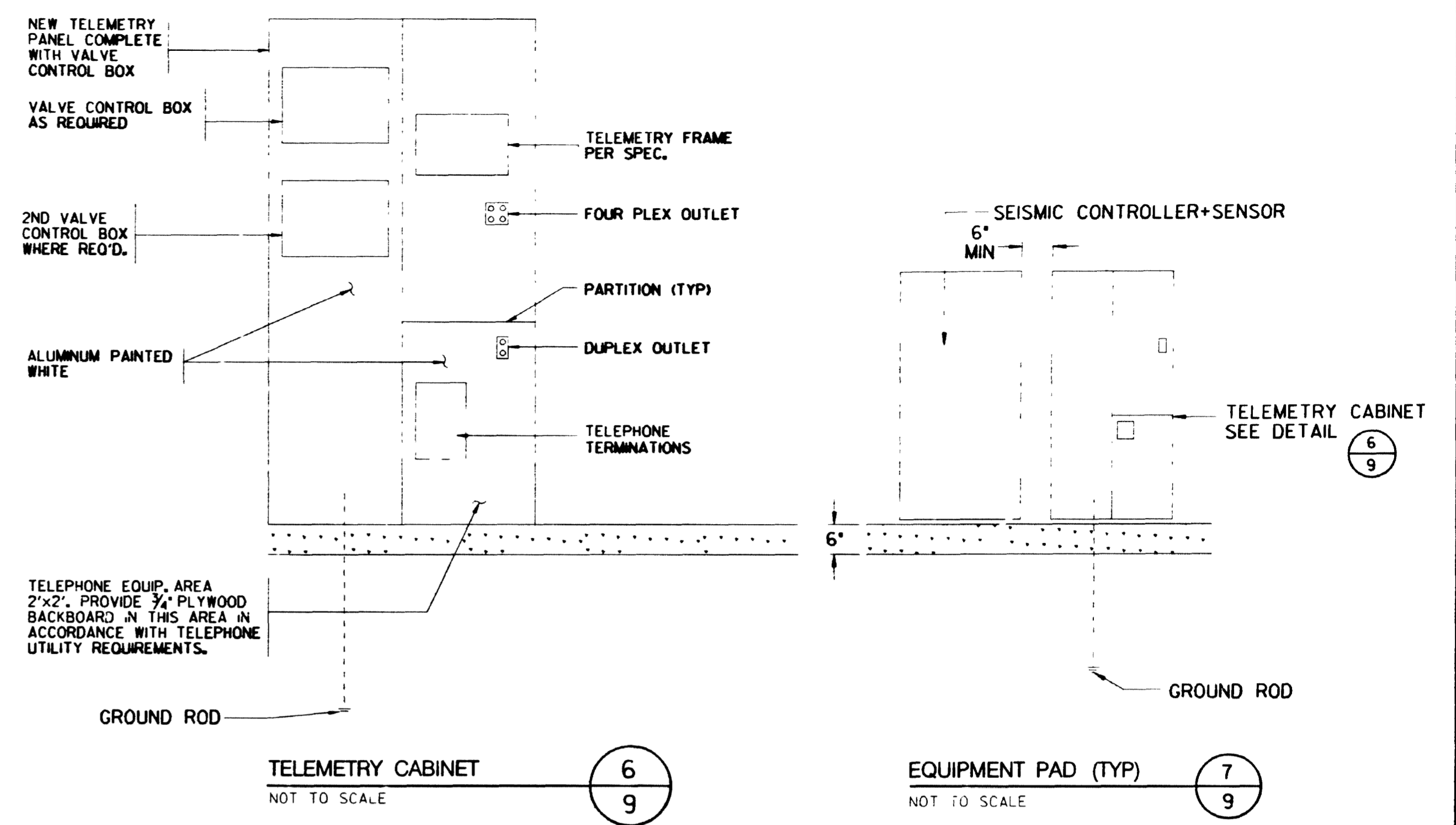
- 1 PRECAST CONCRETE VAULT.
- 2 TYPE 2 WALL PENETRATION SEAL.
- 3 STAINLESS STEEL LADDER. SEE DETAIL 4, SHT. 9
- 4 SAFETY CLIMB WITH REMOVABLE SAFETY EXTENSION POST.
- 5 16" BUTTERFLY VALVE (CLASS 150)
- 6 16" x 10" LONG D.I.P. SPOOL.
- 7 16" ALTITUDE VALVE (CLASS 150)
- 8 RESERVOIR SENSING LINE
- 9 12" x 12" x 12" PRECAST SUMP BOX. SEE DETAIL 5, SHT. 9
- 10 1" TAP AND PRESSURE GAGE
- 11 7'-0" x 8'-0" DOUBLE LEAF HATCH AND FRAME. HINGE ON THE 7 FT. SIDE.
- 12 F.R.P. REMOVABLE GRATING
- 13 CONCRETE VALVE SUPPORT
- 14 32 lb MAGNESIUM ANODE
- 15 COMBINATION 4" AIR AND VACUUM VALVE PER SDW - 117, W - 5
- 16 VELOCITY FLOW METER
- 17 2" TAP WITH 2" CORPORATION COCK
- 18 FLEX COUPLING



LADDER SECTION 4/9
NOT TO SCALE



LADDER PLAN 3/9
NOT TO SCALE



- NOTES**
1. TOP OFF VAULT FLOOR W/ 3000 PSI CONCRETE FOR POSITIVE DRAINAGE INTO SUMP. MAX. CONCRETE AGGREGATE SIZE IS 3/8". MIN. CONCRETE THICKNESS IS 1" MAX. SLOPE IS 1/8" PER FOOT. CLEAN PRECAST CONC. & APPLY SIKADUR 32 BONDING BRIDGE PRIOR TO PLACING TOPPING.
 2. ANGLE SUPPORT TO BE FABRICATED FROM 316L STAINLESS STEEL. ANCHORS TO BE SUPPLIER'S STANDARD STAINLESS STEEL.

GRATING DETAIL 5/9
NOT TO SCALE

GROUP JOB 506		MISCELLANEOUS DETAILS	
CITY OF SAN DIEGO, CALIFORNIA UTILITIES DEPARTMENT SHEET 9 OF 9 SHEETS		ATER W/O 181341	SPWER W/O
ASSIST. UTILITIES DIRECTOR	DATE 4-4-95	<i>Robert C. Staff</i> SUPERVISOR	
DESIGNER	DATE 4-3-95	<i>Jeff Blum</i> DESIGNER	
CONTROL CERTIFICATION		SEE EACH SHEET	
CONTRACTOR	DATE STARTED	NUMBER COORDINATES	
INSPECTOR	DATE COMPLETED	27622-9-D	

MISCELLANEOUS DETAILS

SOLEDAD MOUNTAIN WATER PUMPING PLANT

WORK TO BE DONE

THE IMPROVEMENTS CONSIST OF THE PUMP STATION CONSTRUCTION COMPLETE, INCLUDING PIPING, CONCRETE, PUMPS, MOTORS, ELECTRICAL POWER AND CONTROLS, VALVES, FITTINGS, PAVING, APPURTENANCES AND THE FOLLOWING WORK, ALL TO BE DONE ACCORDING TO THESE PLANS AND STANDARD DRAWINGS, AND SPECIFICATIONS OF THE CITY OF SAN DIEGO

SPECIFICATIONS

CITY OF SAN DIEGO STANDARD SPECIFICATIONS, DOCUMENT NO 727731, FILED APRIL 14, 1969, AND SPECIAL SPECIFICATION NO 2775

STANDARD DRAWINGS

DOCUMENT NO 735691 FILED APRIL 26, 1971

IMPROVEMENTS	STANDARD DRAWINGS	LEGEND
PAVEMENT	—	
A.C BERM	G-21	
RETAINING WALL	C-61	

REFERENCE DRAWINGS:

SOLEDAD RESERVOIR, DRAWING NUMBERS 7574-1 TO 7-W, 7301-W
5198-BL, 5199-L, 13742-2-D, 14479-1 TO 3-D, 14920-3, 6-D
13335-B, 7616-2, 9-W

BENCH MARK:

B P - S D G & E TRANSFORMER STATION, NEAR ENTRANCE ROAD TO SOLEDAD CROSS ELEVATION 748.43, MFAN SEA LEVEL DATUM
T B M. - PK NAIL IN NLY Q EDGE OF VALVE CHAMBER, ELV. = 710.26 M.S.L

FIELD NOTES:

246-1692, BEATTY, W.O 48363, 10-14-64
246-1693, BEATTY, W.O 48363, 11-05-64
244-1692, SMITH, W.O 33694, 4-07-69
244-1692, KELLEY, W.O 33694, 5-27-75
244-1692, WEST, W.O 133031, 1-14-76
244-1692, SHOREY, W.O 33694, 4-24-75

TRAFFIC REQUIREMENT:

SECTION 1.22 STANDARD SPECIFICATIONS

NOTES-

BEFORE EXCAVATING, VERIFY LOCATION OF UNDERGROUND UTILITIES - CONTACT.

GAS & ELECTRIC CO.	232-4252, EXT 1658
TELEPHONE CO	298-0595
WATER & SEWER	236-5650
BLDGs & ELECT.	236-5505
FIRE ALARM	234-6154

APPROVALS	
DEPARTMENTAL PLANNING	ENG DEPT DIVISION OR SECTION CONST INSPECTION
PROPERTY	ELECTRICAL
PUBLIC WORKS	FIELD CHECK
RECREATION	GRADES AND DRAINS
UTILITIES	HIGHWAYS
STRUCTURAL	MONUMENTS
TRAFFIC	PARKS
WATER	SEWERAGE
	STREET ACTIONS

1911 ACT 2775

SOLEDAD MOUNTAIN WATER PUMP PLANT

CITY OF SAN DIEGO, CALIFORNIA
UTILITIES DEPARTMENT
SHEET 1 OF 9 SHEETS

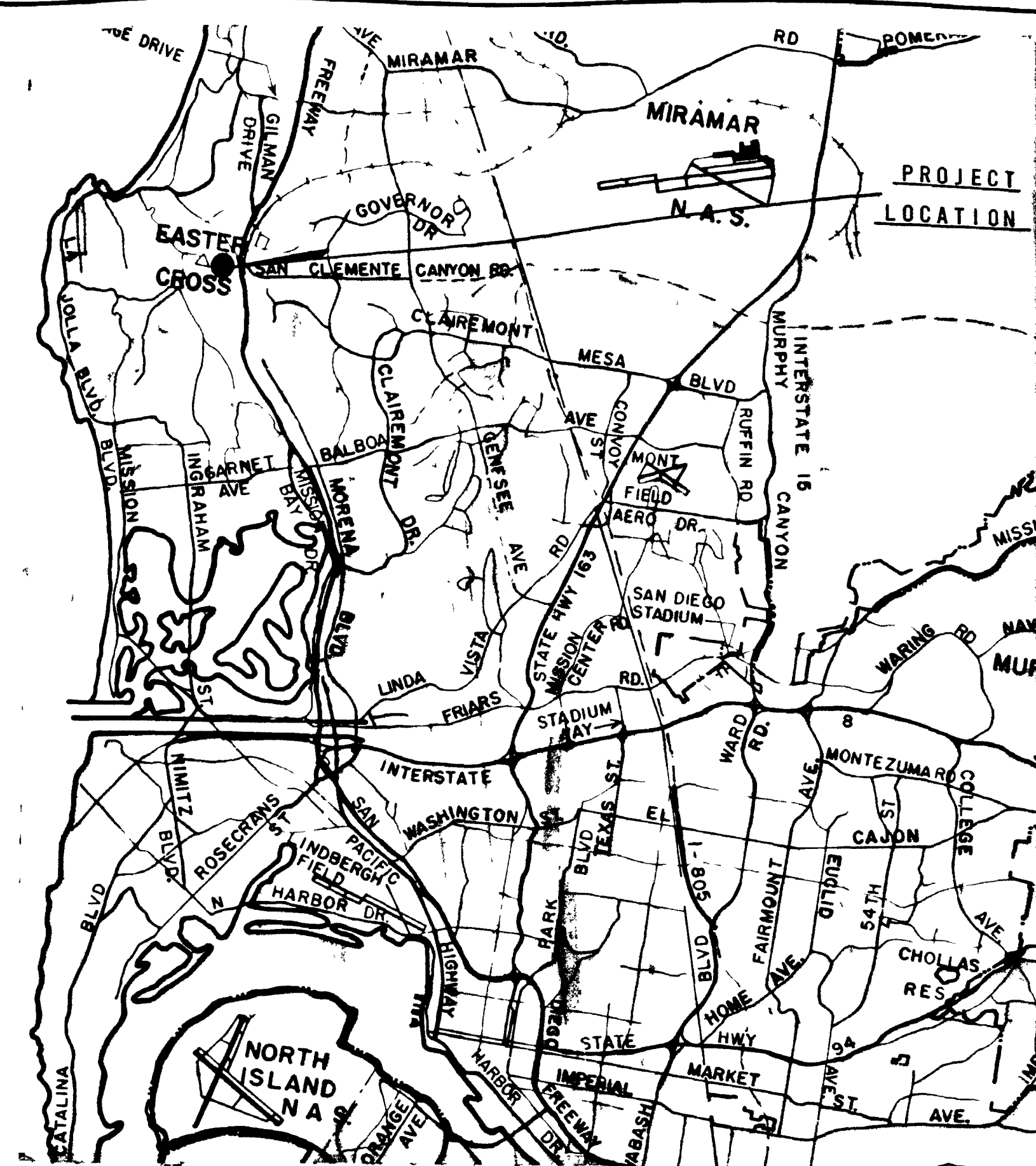
U.D. 123331
U.W. 95571

UTILITIES DIRECTOR *[Signature]* DATE 6/29/77
ENGINEERING SUPERINTENDENT *[Signature]* DATE 6/29/77
DESIGN ENGINEER *[Signature]* DATE 6/29/77

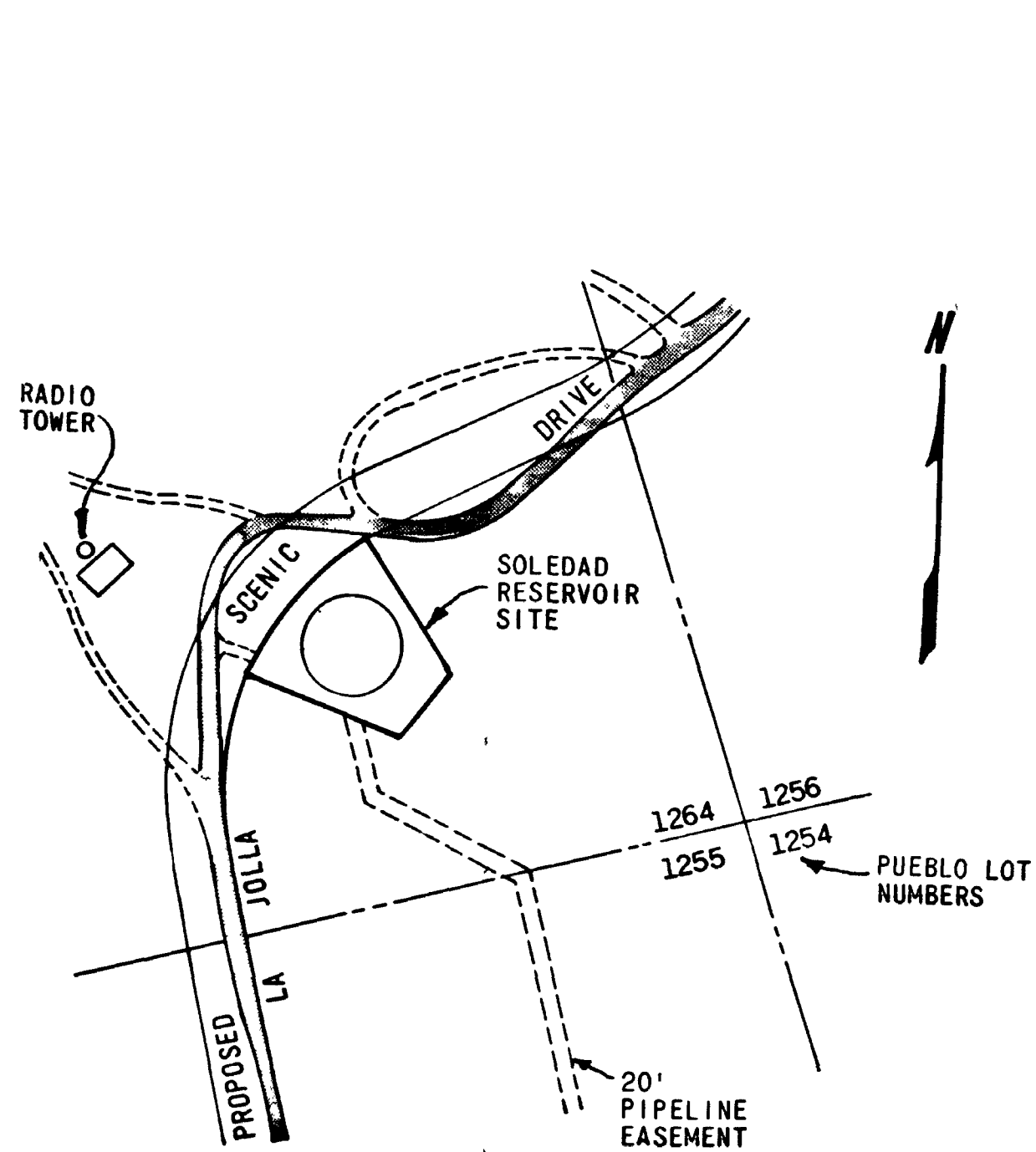
CONSTRUCTION RECORD
CONTRACTOR VIEWLAND DATE STARTED 6-21-77
INSPECTOR BLANKENSHIP DATE COMPLETED 3-15-78
CONNECTIONS BY

CONTROL CERTIFICATION
246-1693
LAMBERT COORDINATES
14853-1-D

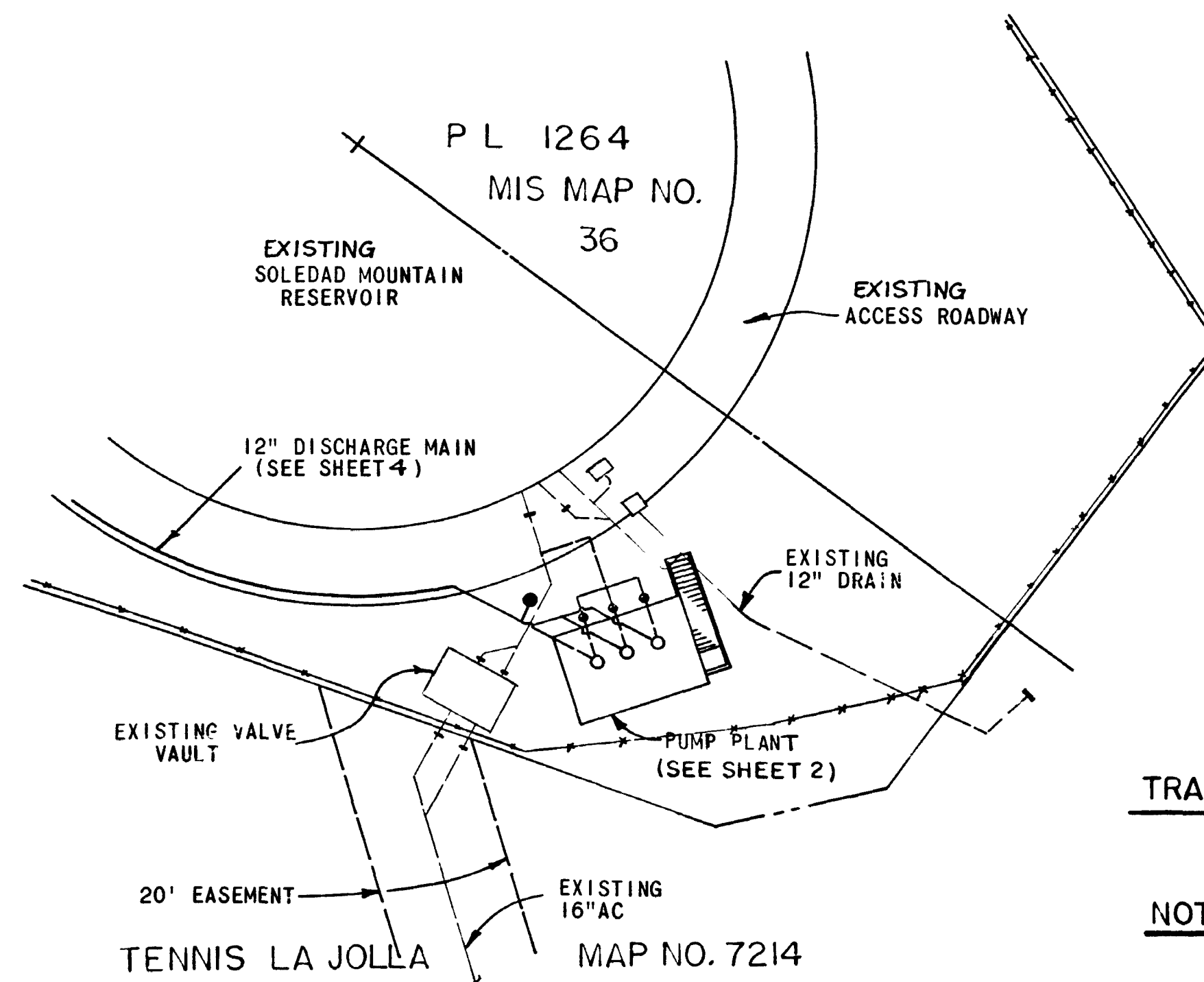
AS-BUILT



LOCATION MAP
SCALE 1" = 8000'



VICINITY MAP
SCALE 1" = 200'

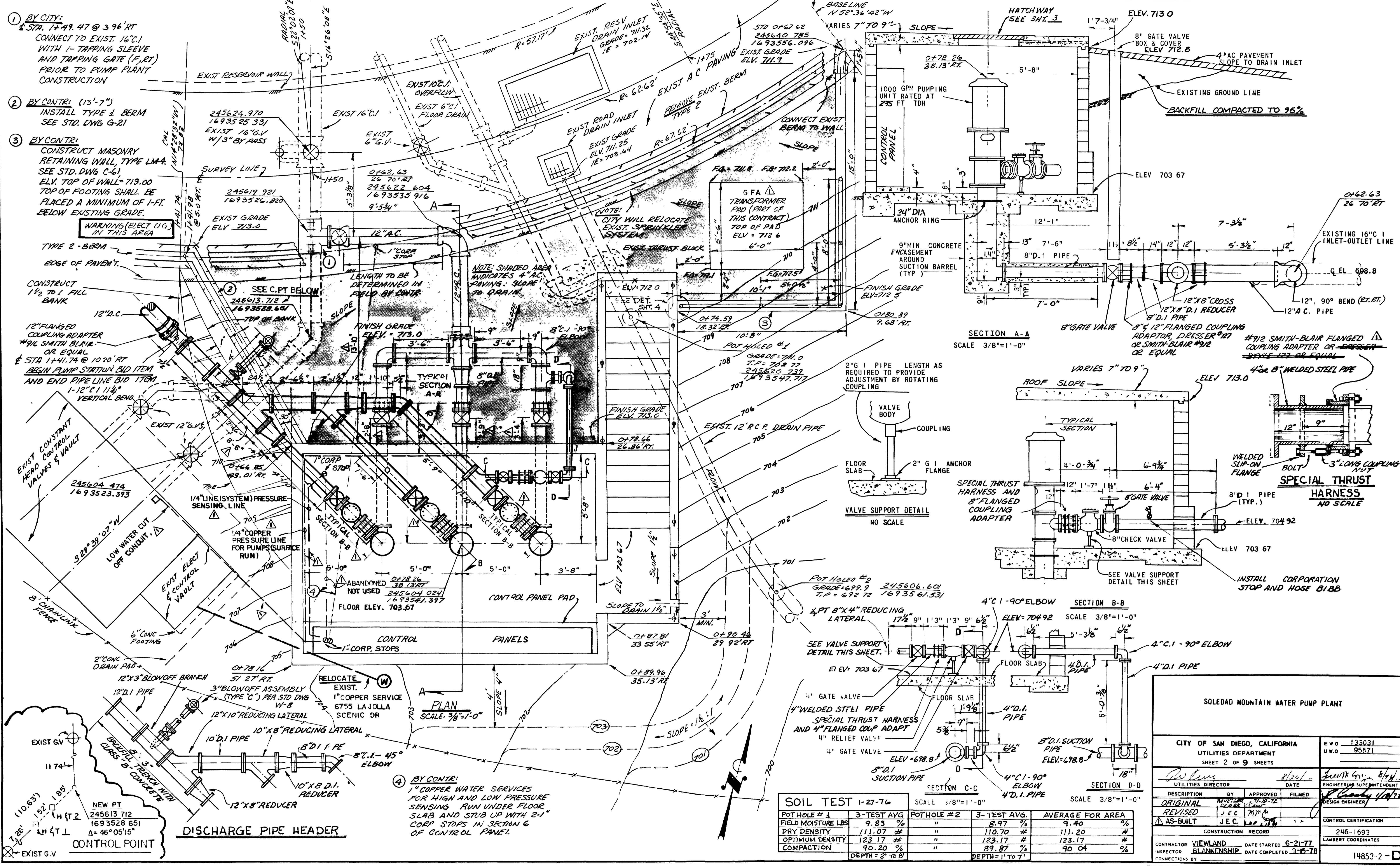


SITE PLAN
SCALE 1" = 20'

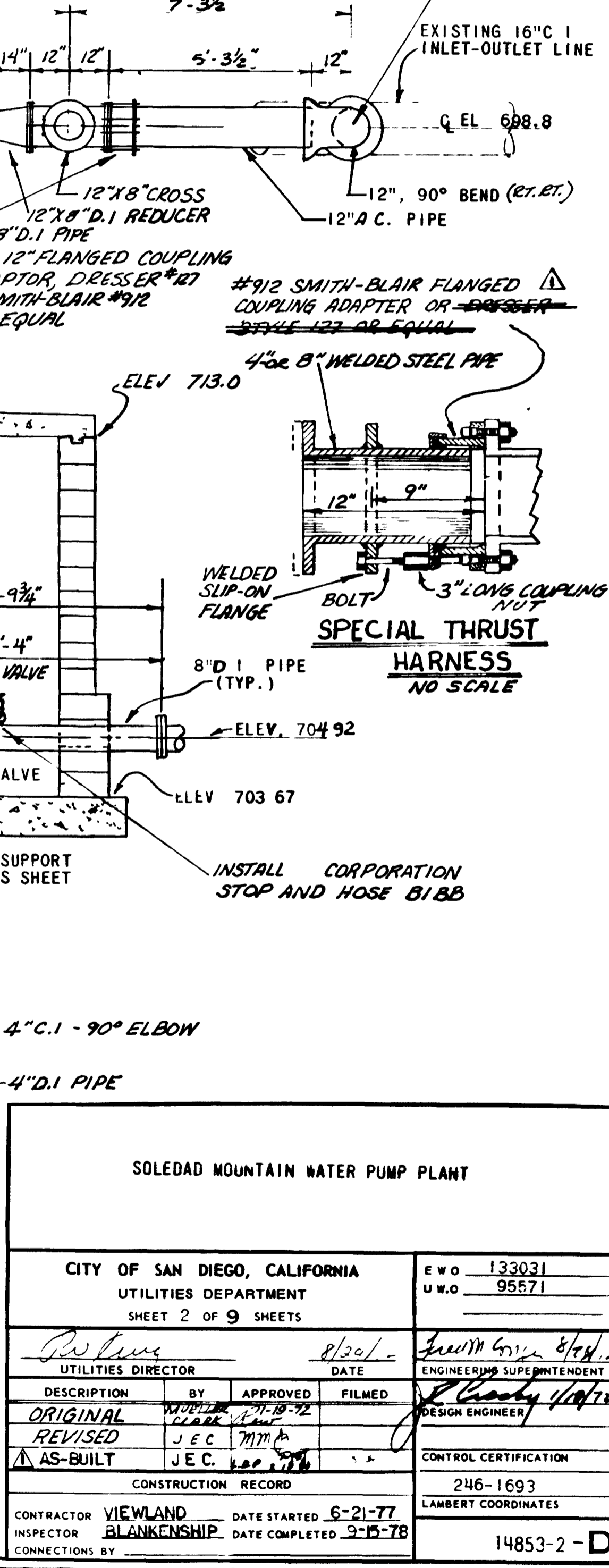
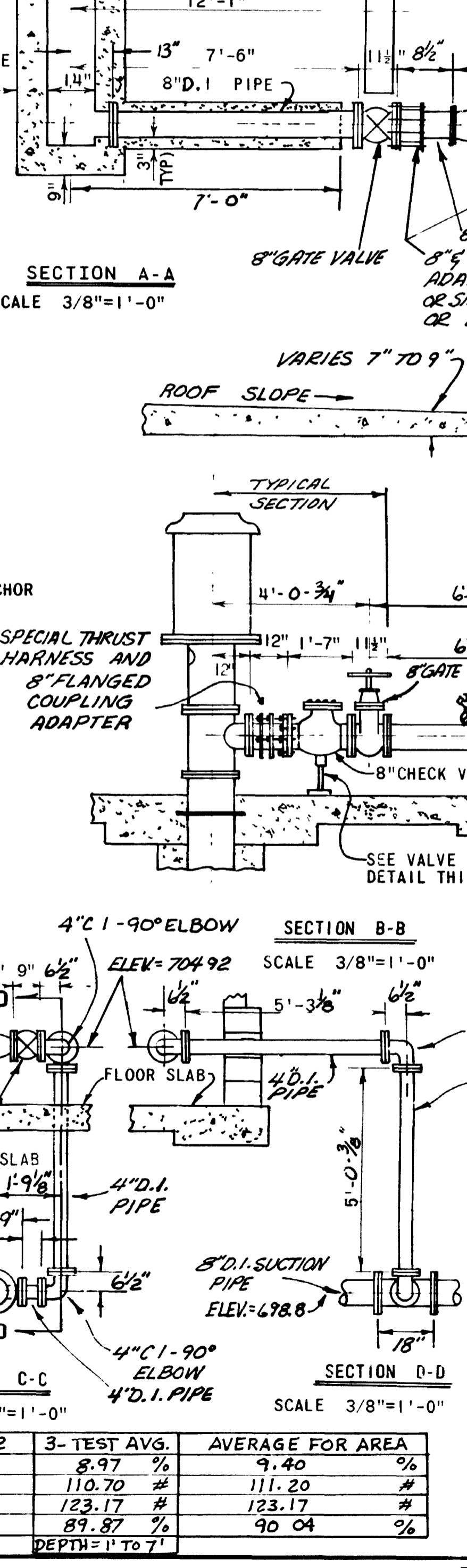
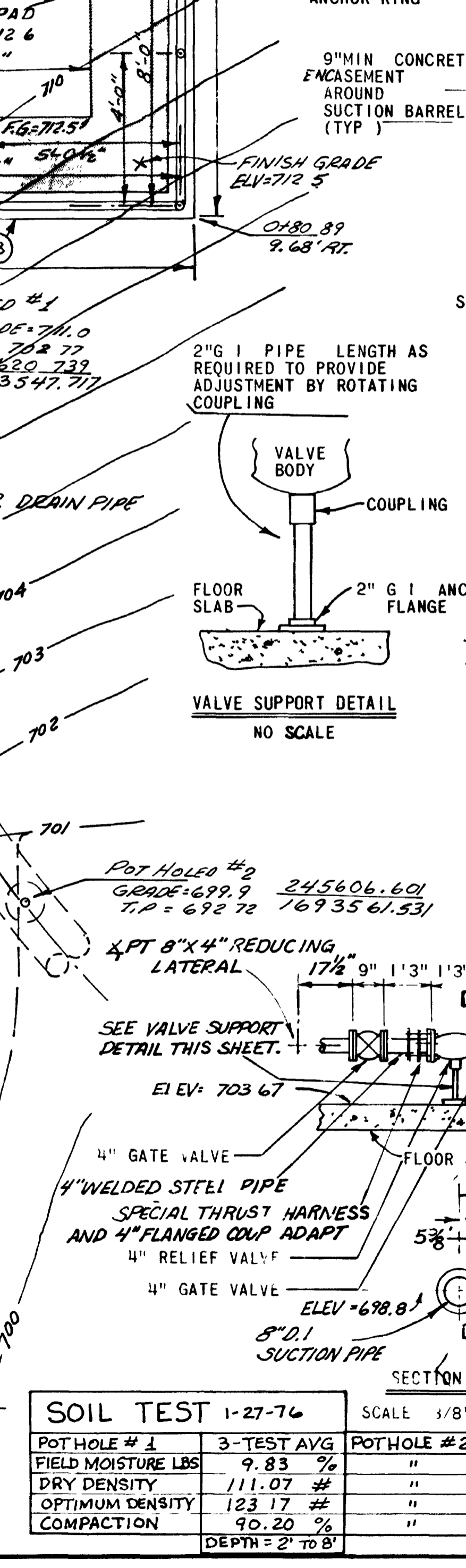
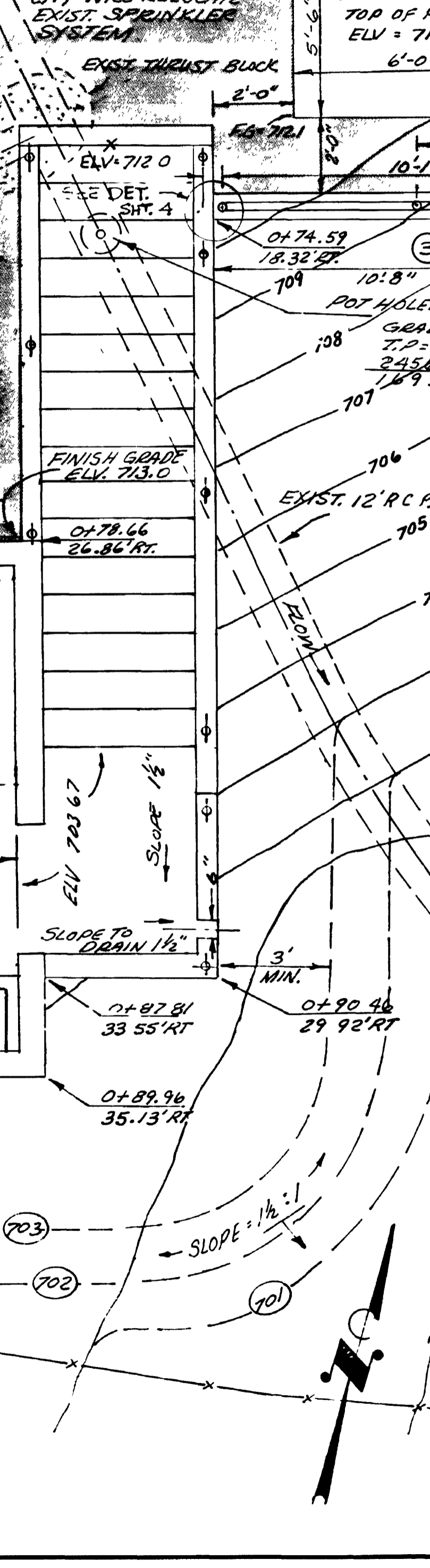
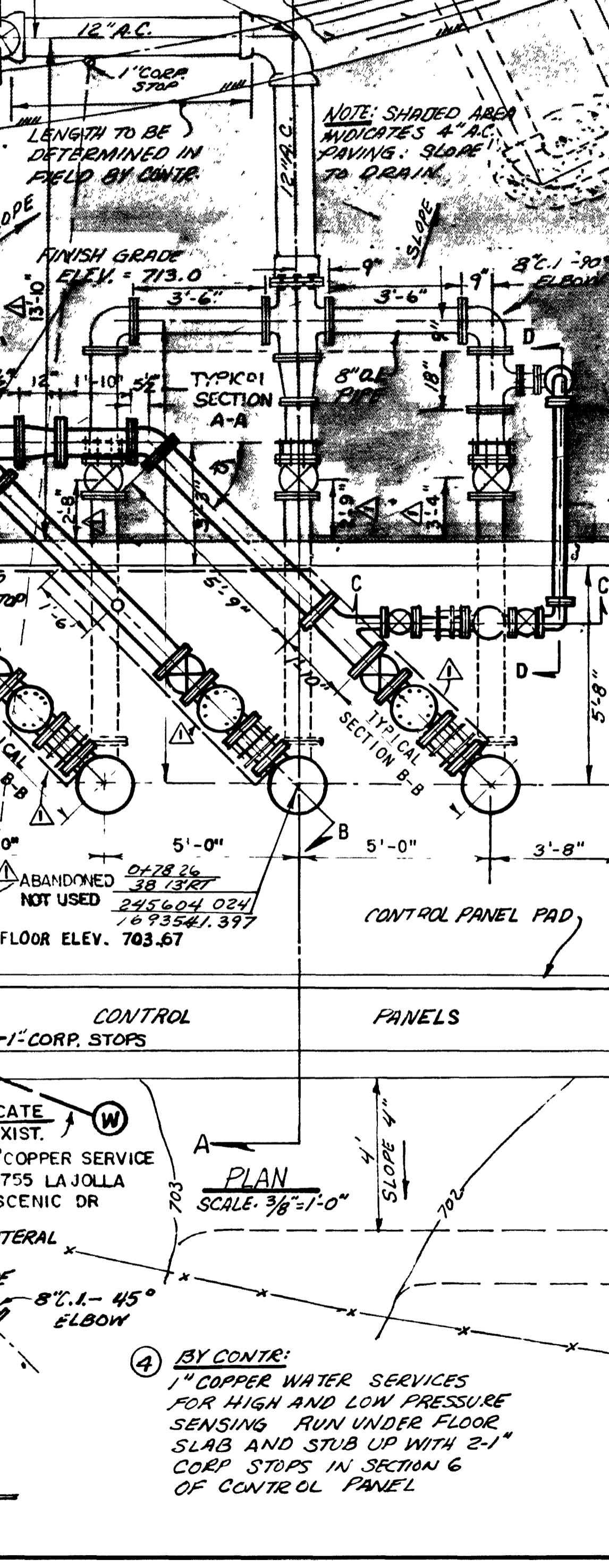
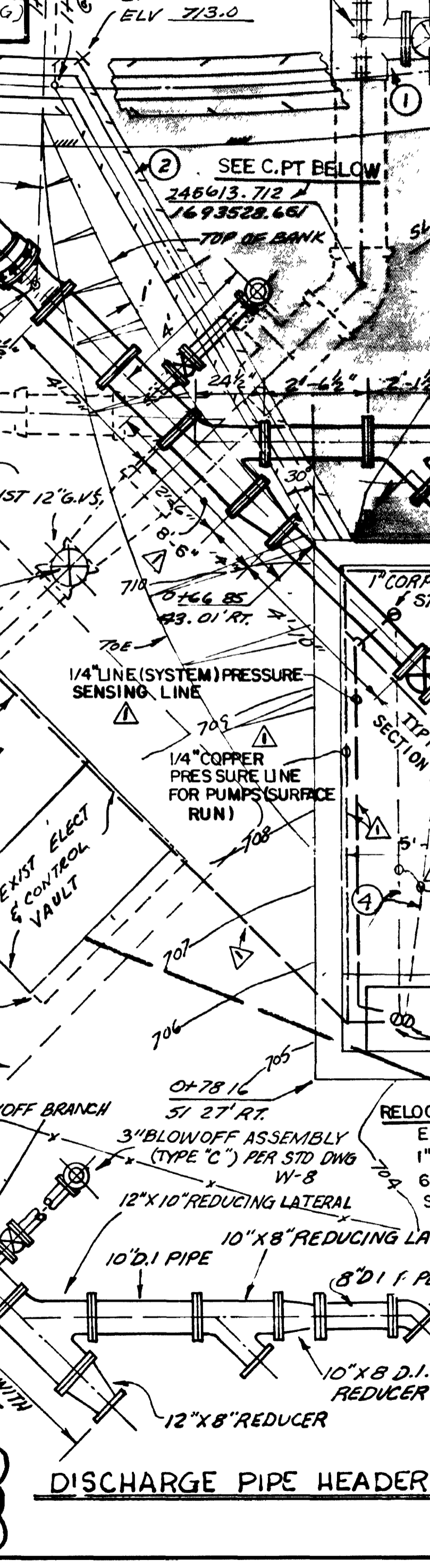
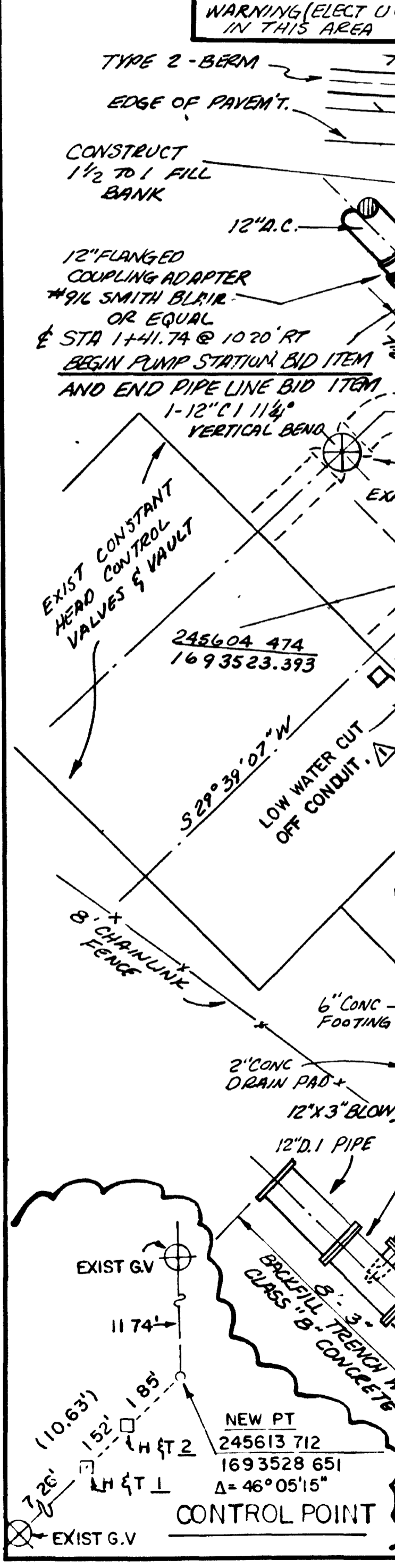
UTILITIES

WORK TO BE DONE SCHEDULE CONTINUED

IMPROVEMENTS	STANDARD DRAWING	LEGEND
WATER MAINS AND APPURTENANCES AS SHOWN THUS	W-6, W-61, W-8, W-26, P-1,	
GATE VALVES WITH 8" VALVE BOXES AND COVERS AS SHOWN THUS.	W-71, W-72	
6" FIRE HYDRANTS AND FIRE HYDRANTS SERVICE AS SHOWN THUS	W-14, W-15, W-17	
2" AIR VALVE ASSEMBLY	W-42	
BLOW-OFF ASSEMBLY	W-8	
WATER SERVICES AS SHOWN THUS (1" UNLESS OTHERWISE SHOWN)	W-2, W-27, W-59, W-35 W-69	



- ① BY CITY:
 STA. 17+49.47 @ 3.96' RT
 CONNECT TO EXIST. 16\"/>
- ② BY CONTR:
 (13'-7\")
 INSTALL TYPE 1 BERM
 SEE STD. DWG G-21
- ③ BY CONTR:
 CONSTRUCT MASONRY
 RETAINING WALL, TYPE LMA.
 SEE STD. DWG C-61.
 ELEV. TOP OF WALL = 713.00
 TOP OF FOOTING SHALL BE
 PLACED A MINIMUM OF 1-FT.
 BELOW EXISTING GRADE.



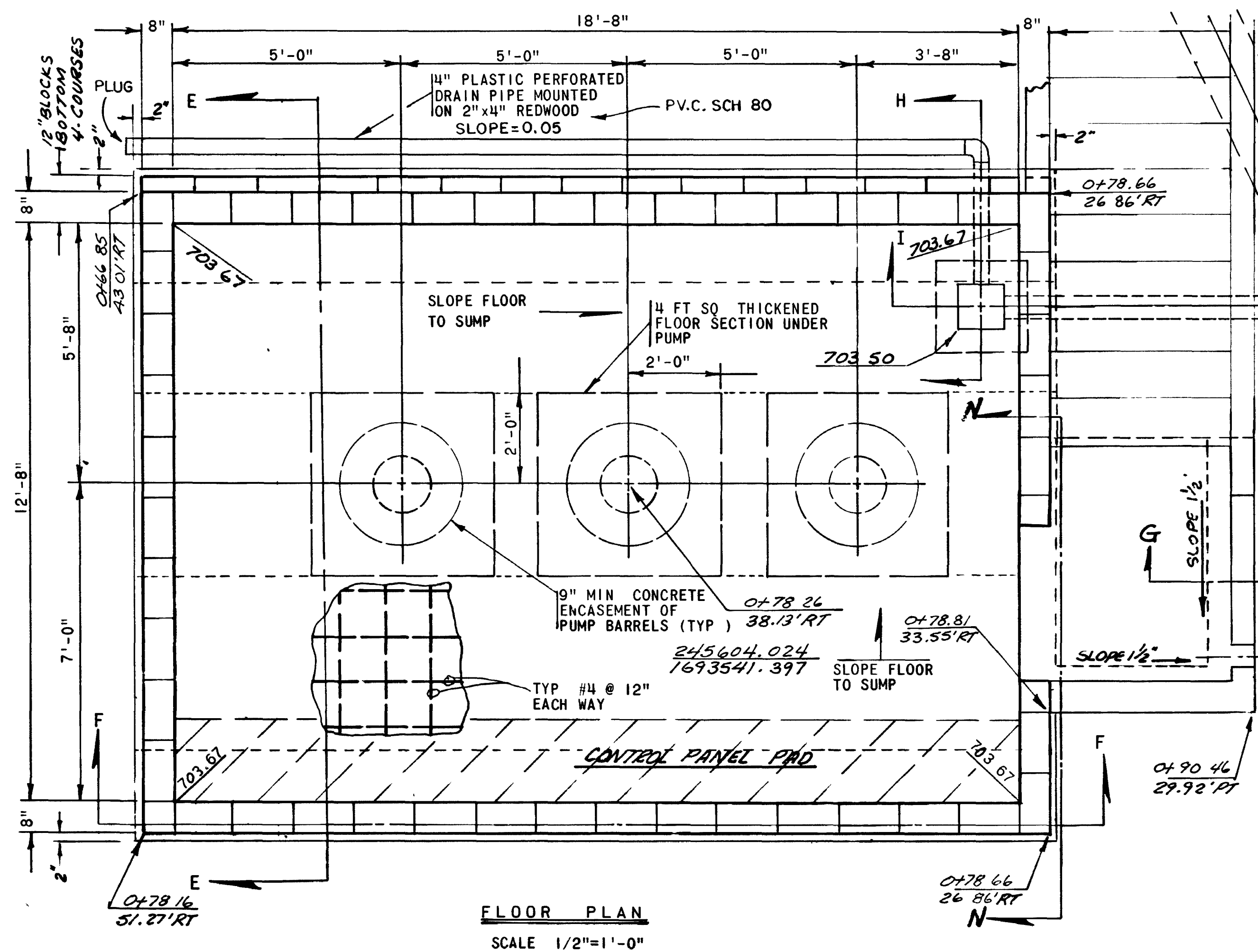
SOIL TEST 1-27-76 SCALE 3/8"=1'-0"

POT HOLE # 1	3-TEST AVG	POT HOLE # 2	3-TEST AVG	AVERAGE FOR AREA
FIELD MOISTURE LBS	9.83 %	"	8.97 %	9.40 %
DRY DENSITY	111.07 #	"	110.70 #	111.20 #
OPTIMUM DENSITY	123.17 #	"	123.17 #	123.17 #
COMPACTION	90.20 %	"	89.87 %	90.04 %
DEPTH = 2' TO 8'		DEPTH = 1' TO 7'		

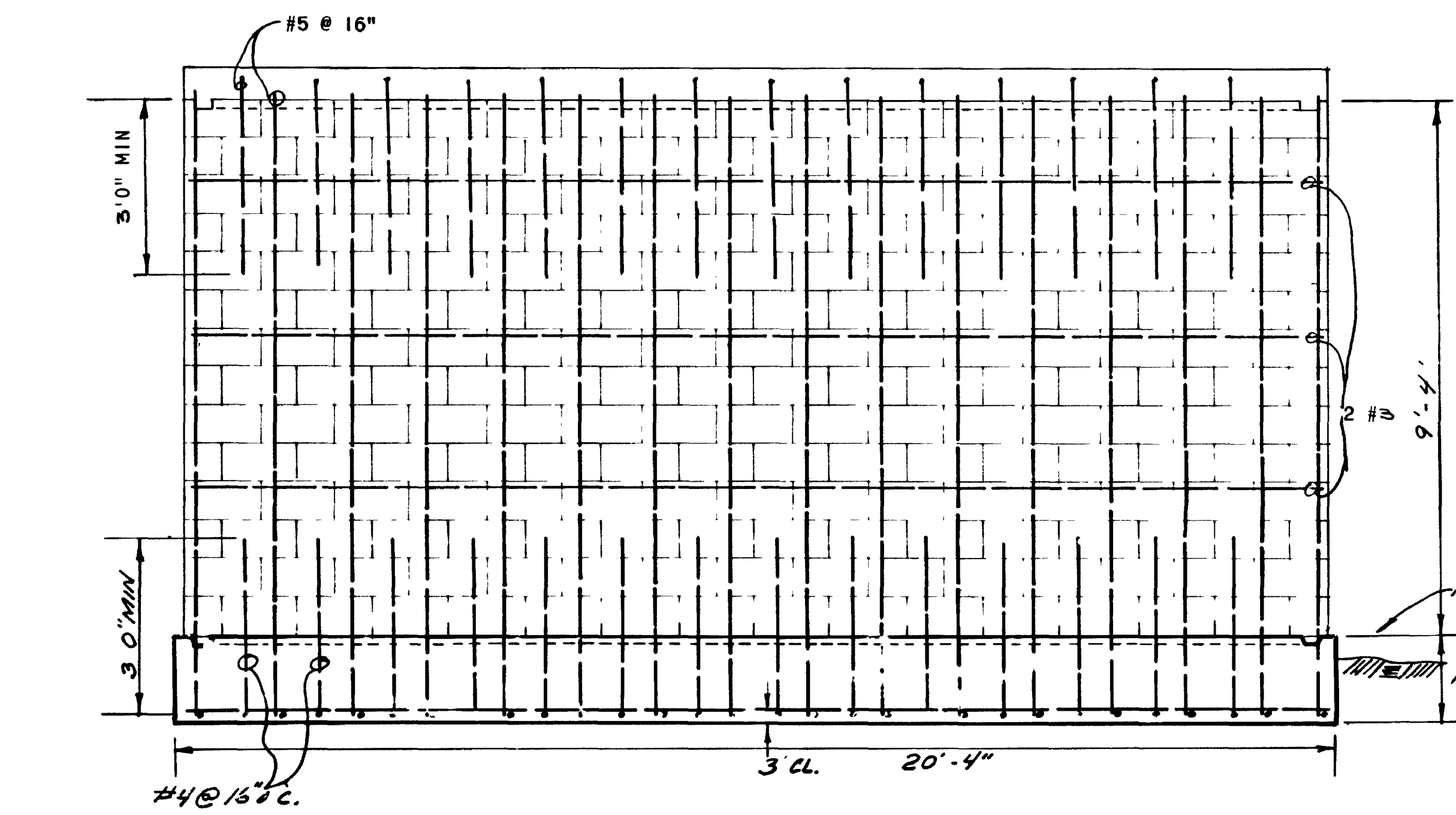
SOLEDAD MOUNTAIN WATER PUMP PLANT

CITY OF SAN DIEGO, CALIFORNIA UTILITIES DEPARTMENT SHEET 2 OF 9 SHEETS		E.W. 133031 U.W. 95571
UTILITIES DIRECTOR	DATE 8/30/76	ENGINEERING SUPERINTENDENT
DESCRIPTION	BY	APPROVED
ORIGINAL	J.E.C.	8-18-72
REVISED	J.E.C.	7/17/76
AS-BUILT	J.E.C.	1/27/78
CONSTRUCTION RECORD		CONTROL CERTIFICATION
CONTRACTOR VIEWLAND		DATE STARTED 6-21-77
INSPECTOR BLANKENSHIP		DATE COMPLETED 3-15-78
CONNECTIONS BY		LAMBERT COORDINATES
		246-1693
		14853-2-D

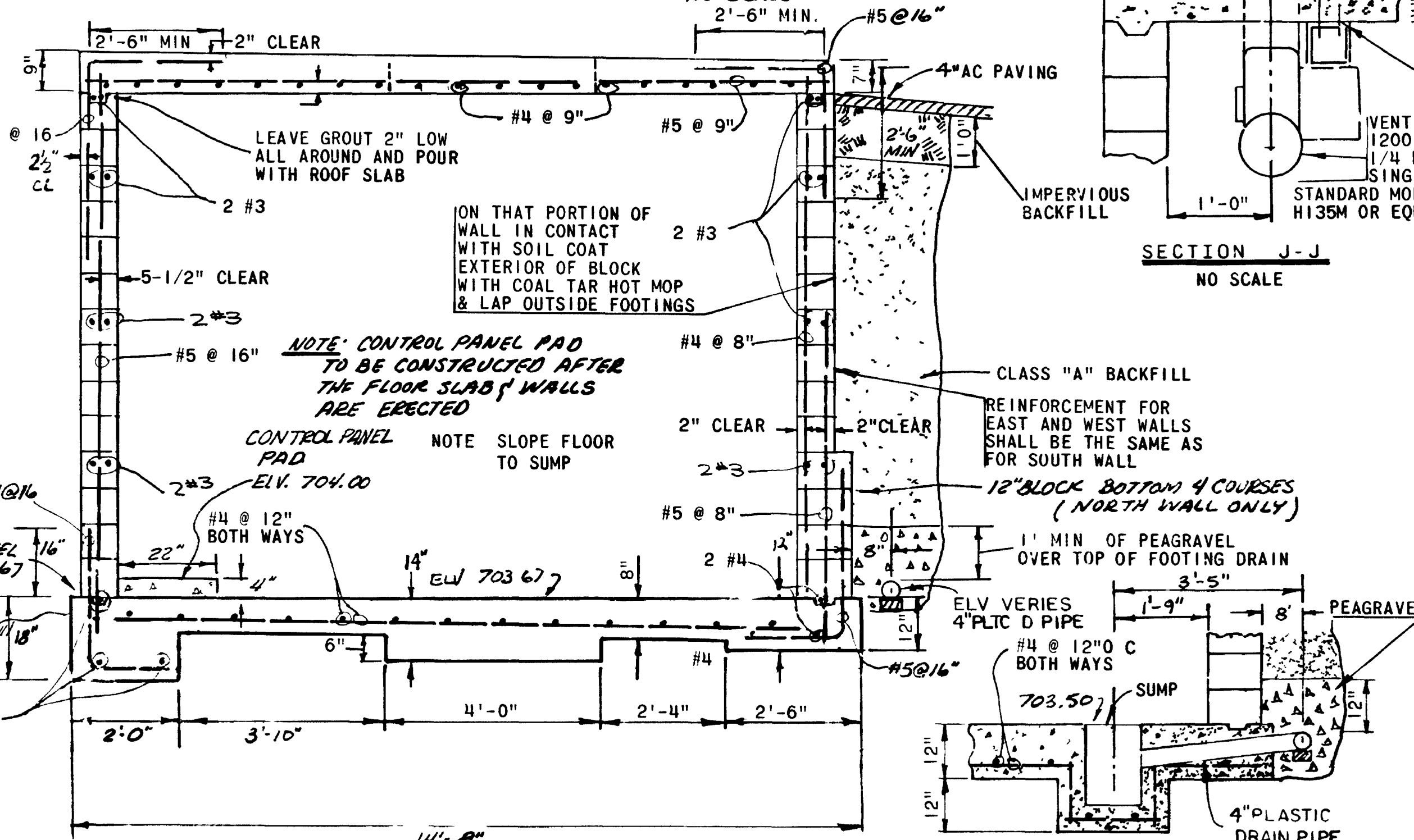
AS-BUILT



FLOOR PLAN
SCALE 1/2"=1'-0"



SECTION F-F
SCALE 1/2"=1'-0"

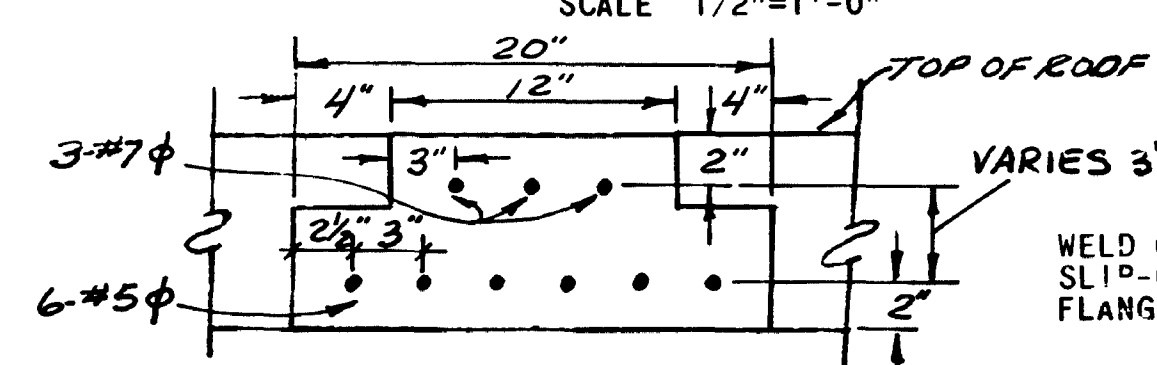


SECTION E-E
SCALE 1/2"=1'-0"

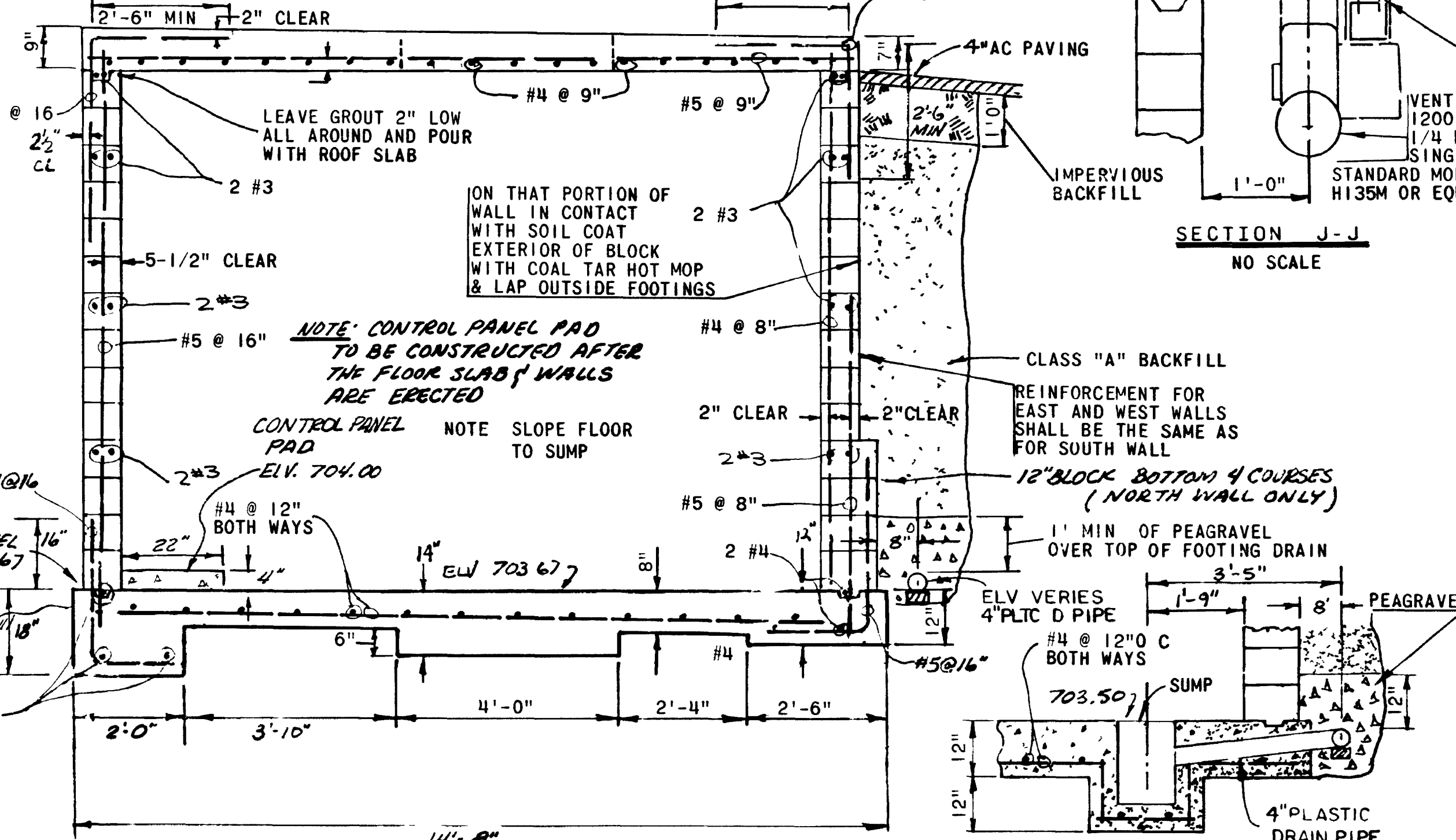
NOTE ALL BACKFILL UNDER FLOOR SLAB TO BE CLASS "A" COMPACTED TO 95%



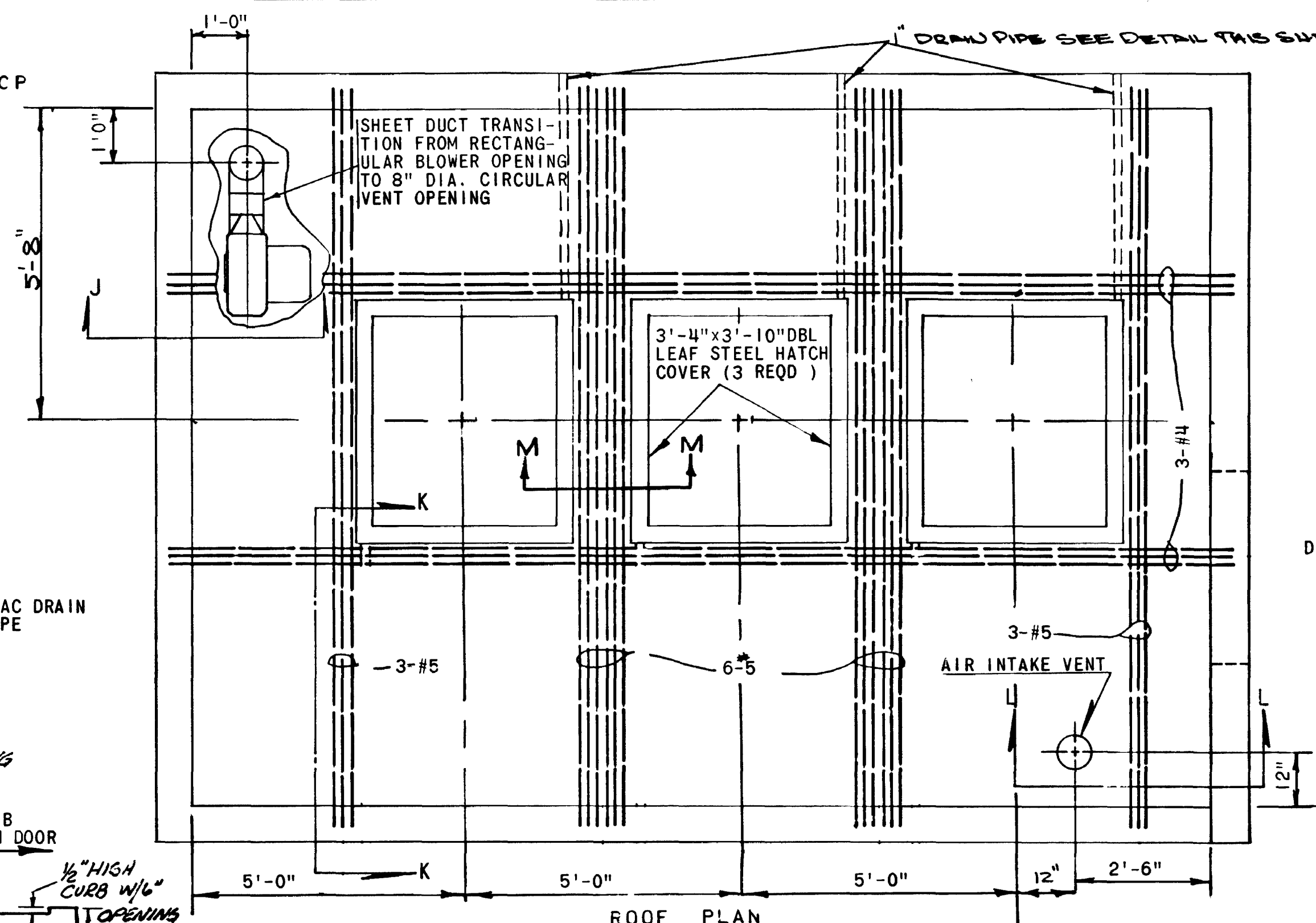
SECTION G-G
SCALE 1/2"=1'-0"



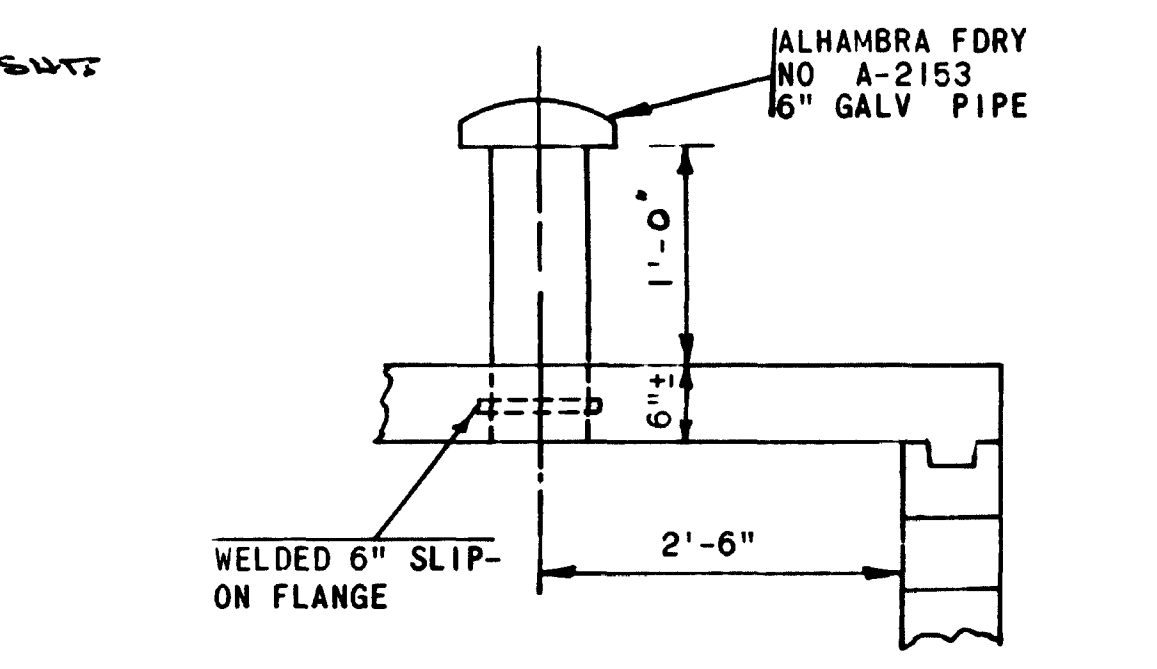
SECTION M-M
NO SCALE



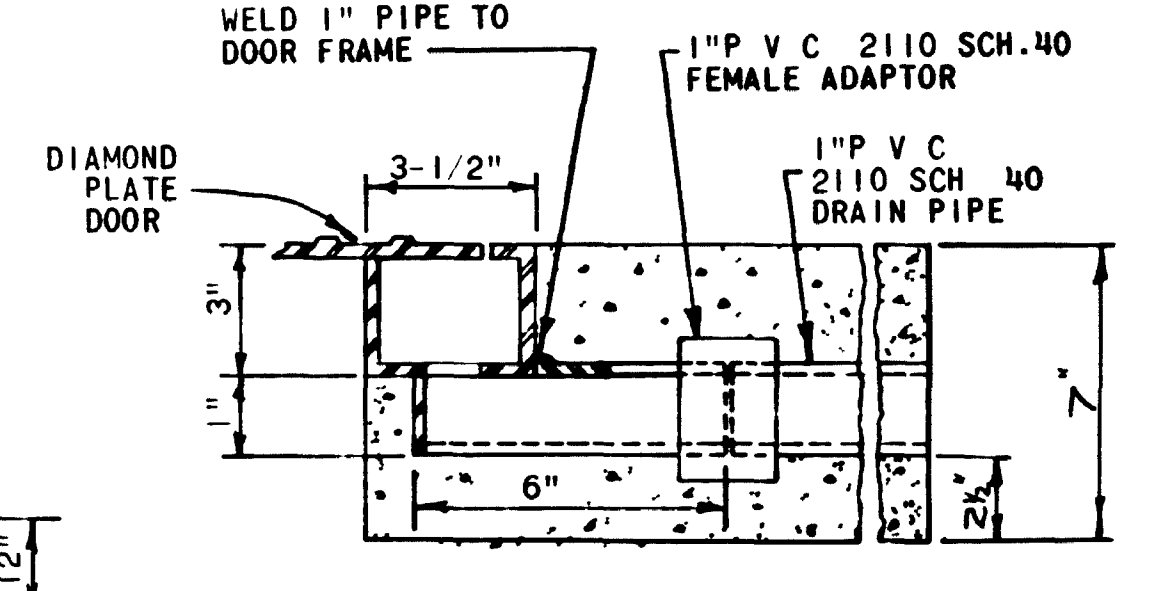
SECTION H-H
SCALE 1/2"=1'-0"



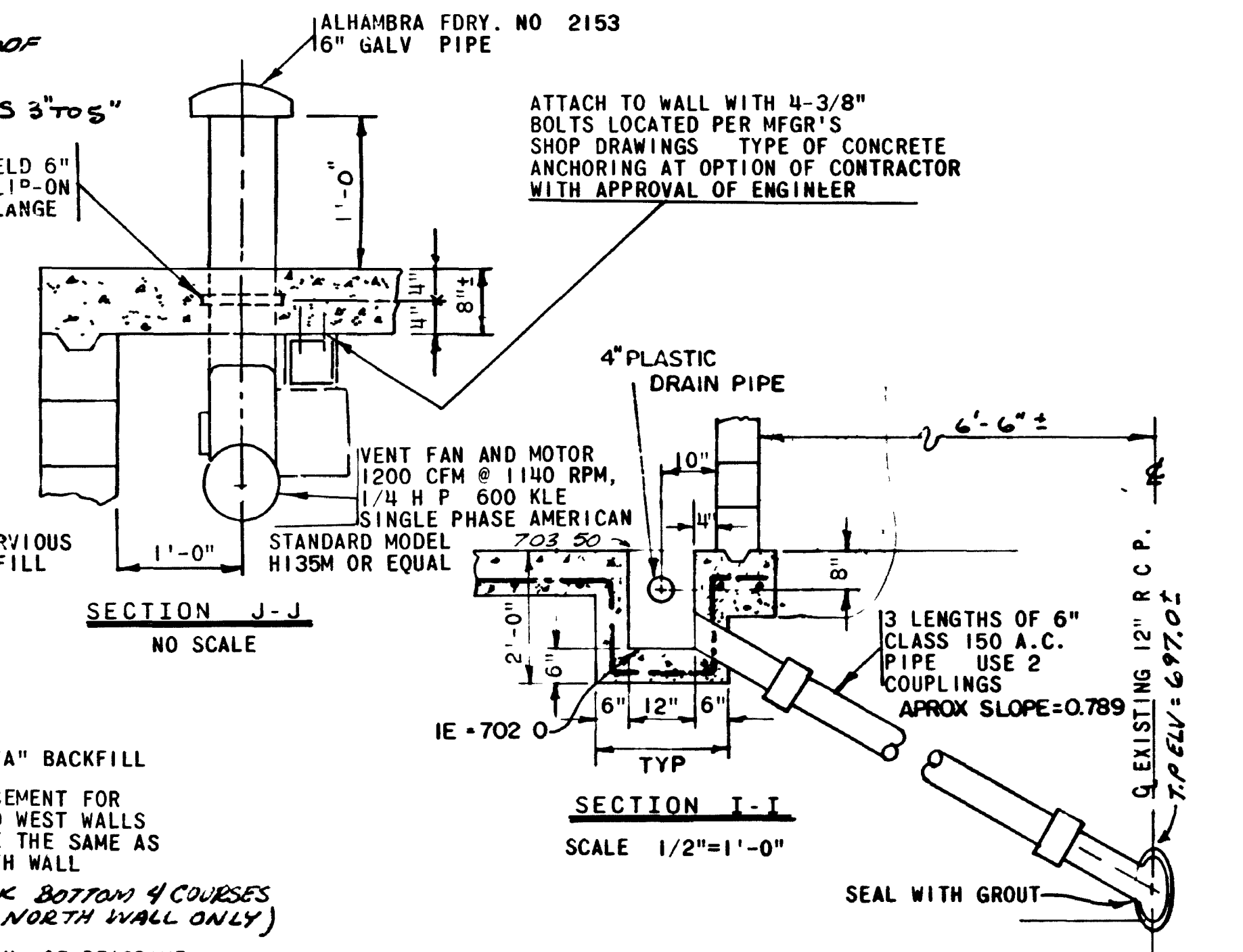
ROOF PLAN
SCALE 1/2"=1'-0"



SECTION L-L
NO SCALE



DRAIN CONNECTION FOR ROOF HATCH
NO SCALE

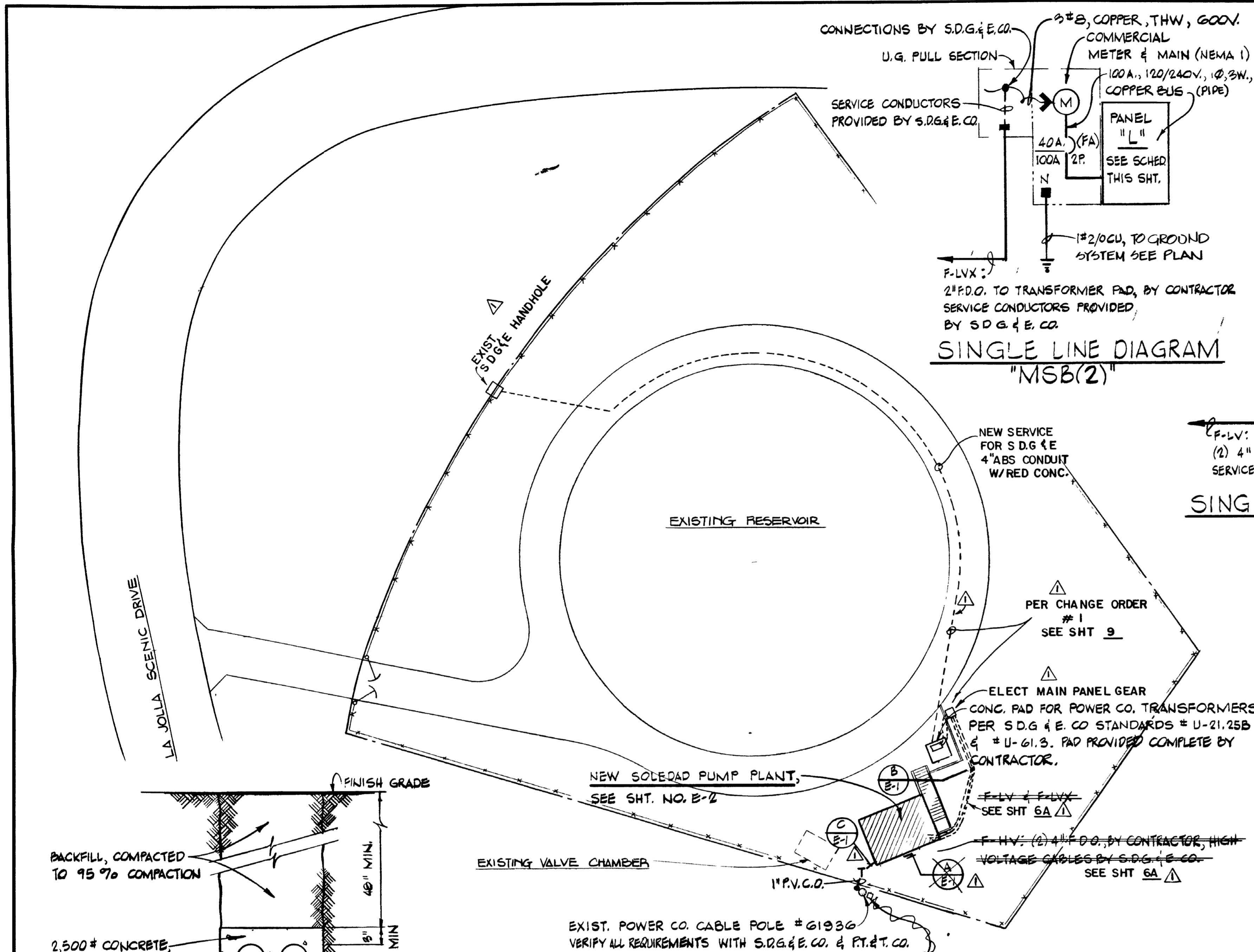


SECTION J-J
NO SCALE

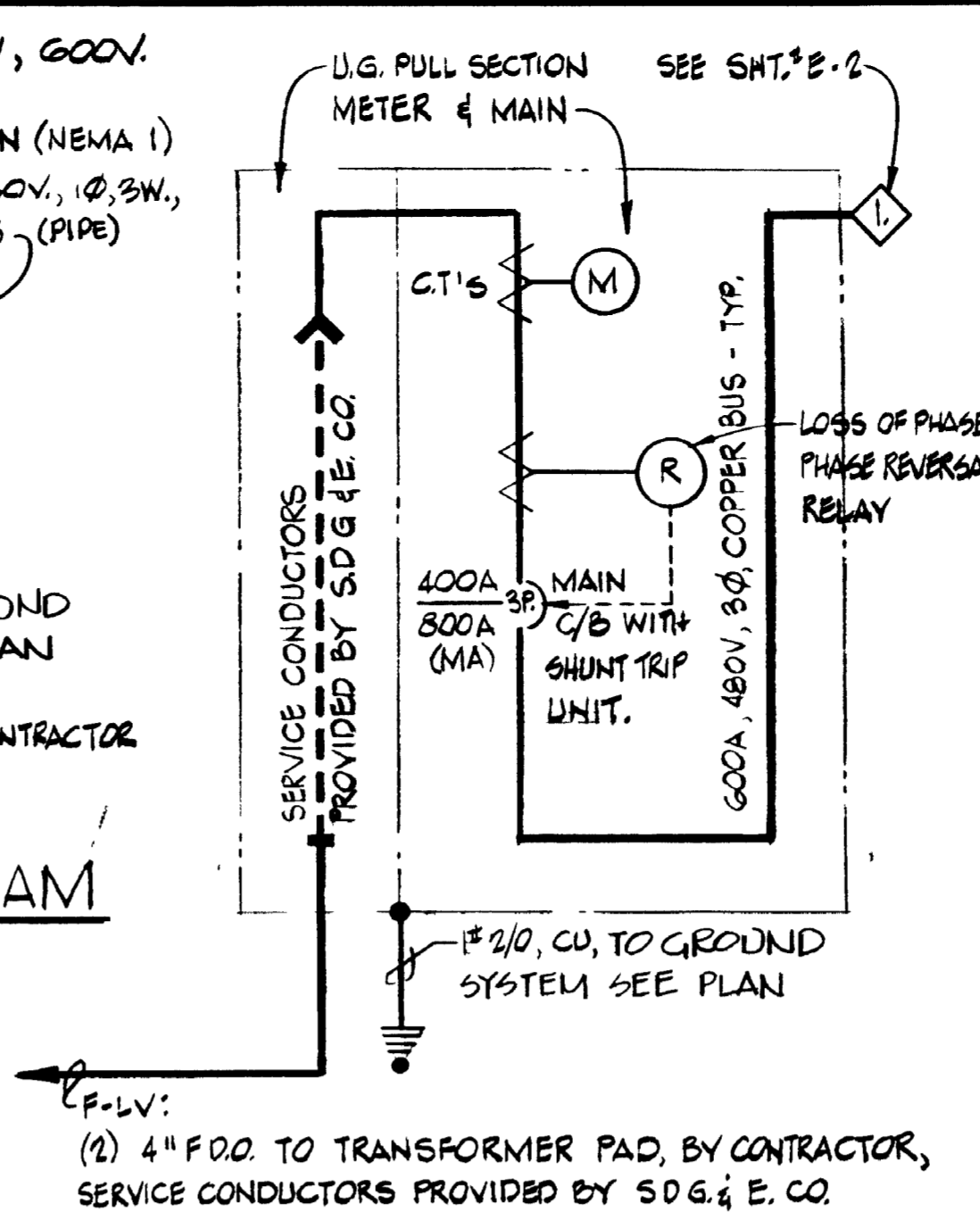
SECTION I-I
SCALE 1/2"=1'-0"

SOLEDAD MOUNTAIN WATER PUMP PLANT			
CITY OF SAN DIEGO, CALIFORNIA UTILITIES DEPARTMENT SHEET 3 OF 9 SHEETS		E.W.O. 133031 U.W.O. 95571	
DATE: 8/29/72	BY: J.F.C.	APPROVED: J.F.C.	FILED: J.F.C.
DESCRIPTION: ORIGINAL	BY: J.F.C.	APPROVED: J.F.C.	FILED: J.F.C.
REVISION: REVISED	BY: J.F.C.	APPROVED: J.F.C.	FILED: J.F.C.
AS-BUILT	J.F.C.	J.F.C.	J.F.C.
CONTRACTOR: VIEWLAND		DATE STARTED: 6-21-77	
INSPECTOR: BLANKENSHIP		DATE COMPLETED: 9-15-79	
CONNECTIONS BY:		CONTROL CERTIFICATION: 246-1693	
		LAMBERT COORDINATES: 14853-3-D	

AS-BUILT



SINGLE LINE DIAGRAM "MSB(2)"



SINGLE LINE DIAGRAM "MSB(1)"

PANEL "CP" 120V, 1Ø, 2W, TYPE NLAB

CKT NO.	CIRCUIT BREAKER	LOAD WATTS	BUS "A"	BUS "B"	CIRCUIT DESCRIPTION
1	20A 1P	1500			CONTROLS
2	15A 1P	500			120V. MTR. HTR.
3		500			
4		500			
5	1P SPACE				SPACE
6					
MAIN 40A 1P 3000					100 AMP BUS
TOTAL 3000 W @ 120V, 1Ø = 25 AMPS					COPPER BUS (PIPE) SEE SHT 2

ALL CIRCUIT BREAKERS SHALL HAVE MIN 1C. OF 10K. AMPS. SYMMETRICAL

PANEL "L" 120/240V, 1Ø, 2W TYPE NQOB OR SURFACE MTD EQUAL

CKT NO.	CIRCUIT BREAKER	LOAD WATTS	BUS "A"	BUS "B"	CIRCUIT DESCRIPTION
1	20A 1P	900			Ø LTS.
2		500			SPARE
3	G.F.C.I		720		Z C/O
4	15A 1P	607			1/4 H.P., 120V, FAN
5	1P SPACE				SPACE
6					
7					
8					
9					
10					
11					
12					
MAIN M.L.O. 1400					13Ø7 100 AMP BUS
TOTAL 2787 WATTS @ 240V, 1Ø = 12 AMPS					COPPER BUS (PIPE) SEE SHT. 2

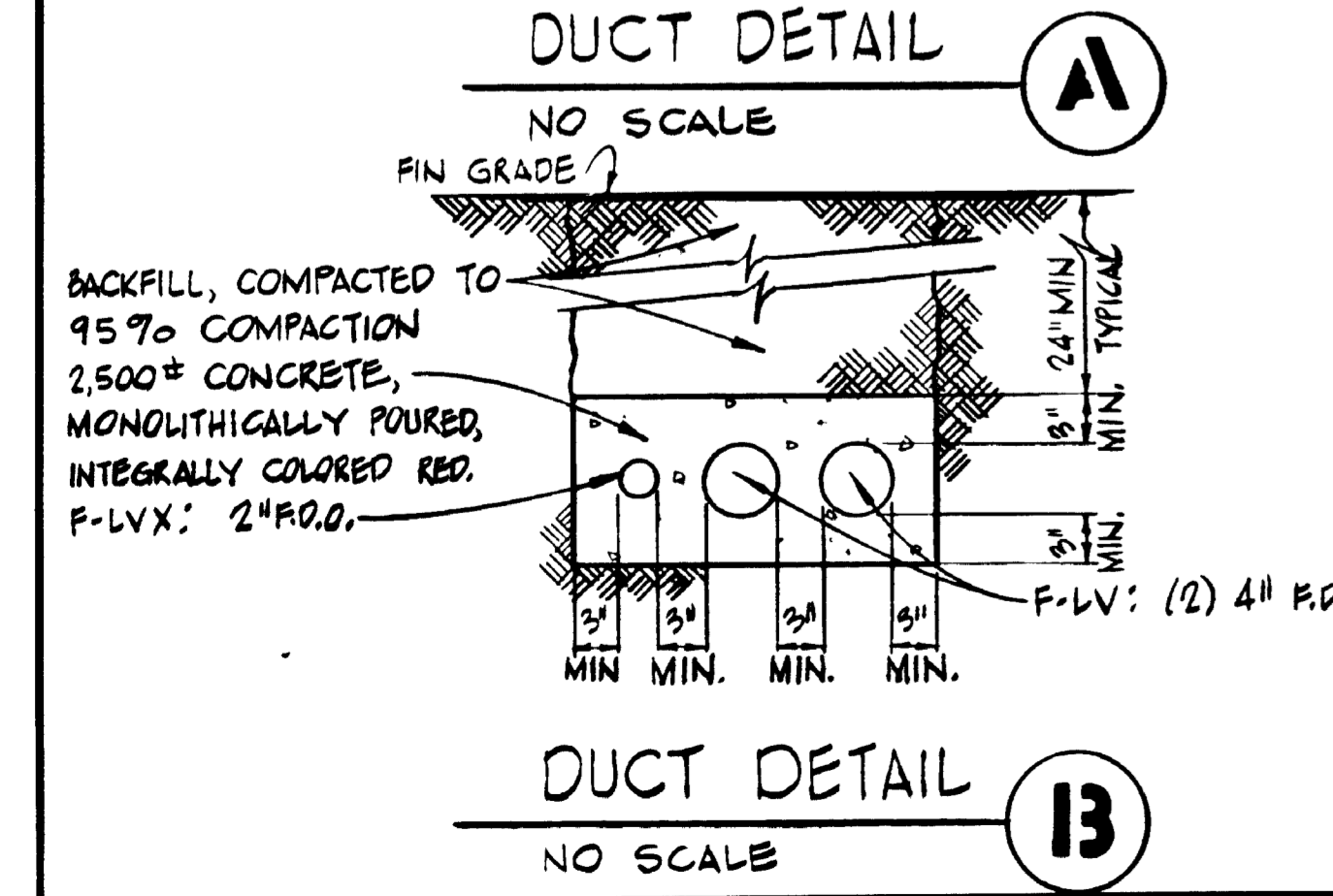
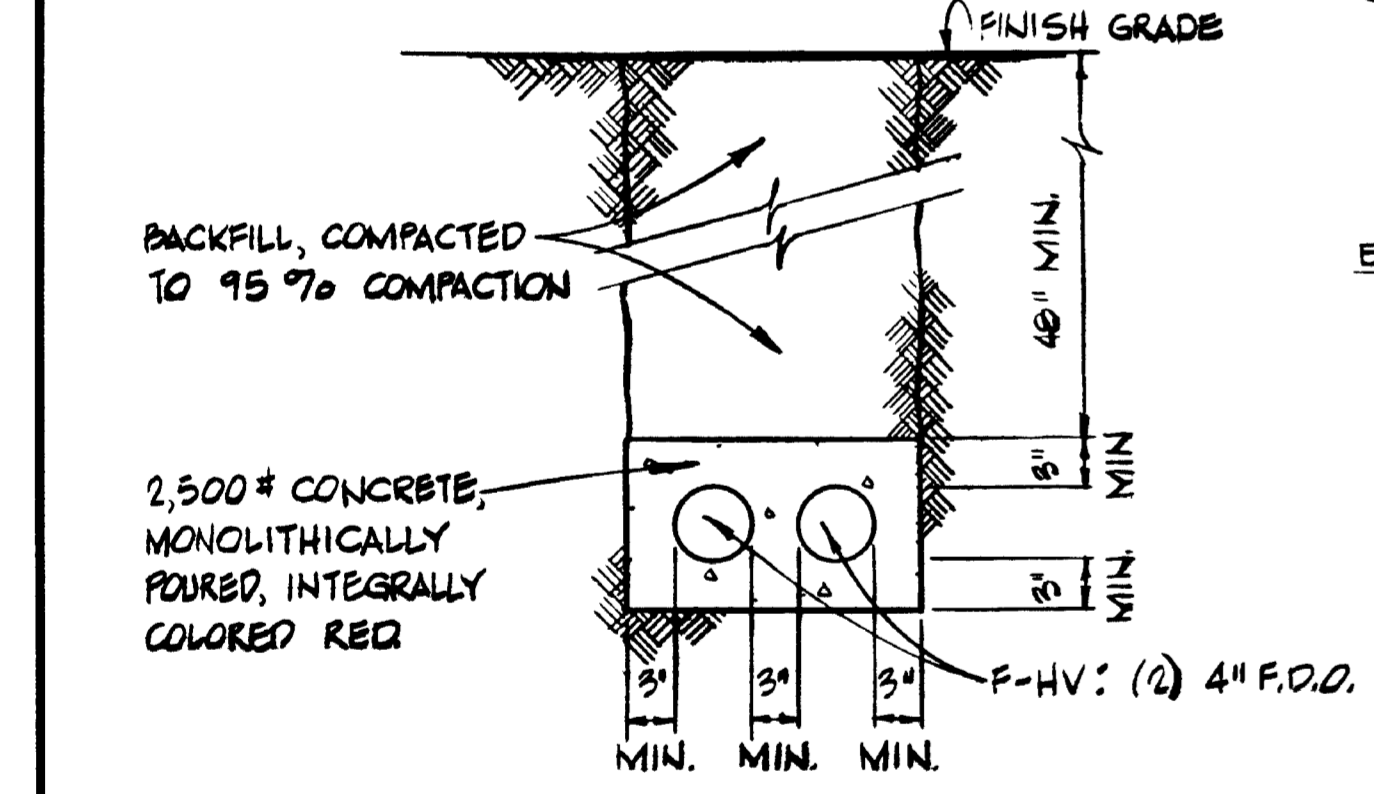
ALL CIRCUIT BREAKERS SHALL MIN 1C. OF 10K. AMPS SYMMETRICAL.

SYMBOL SCHEDULE

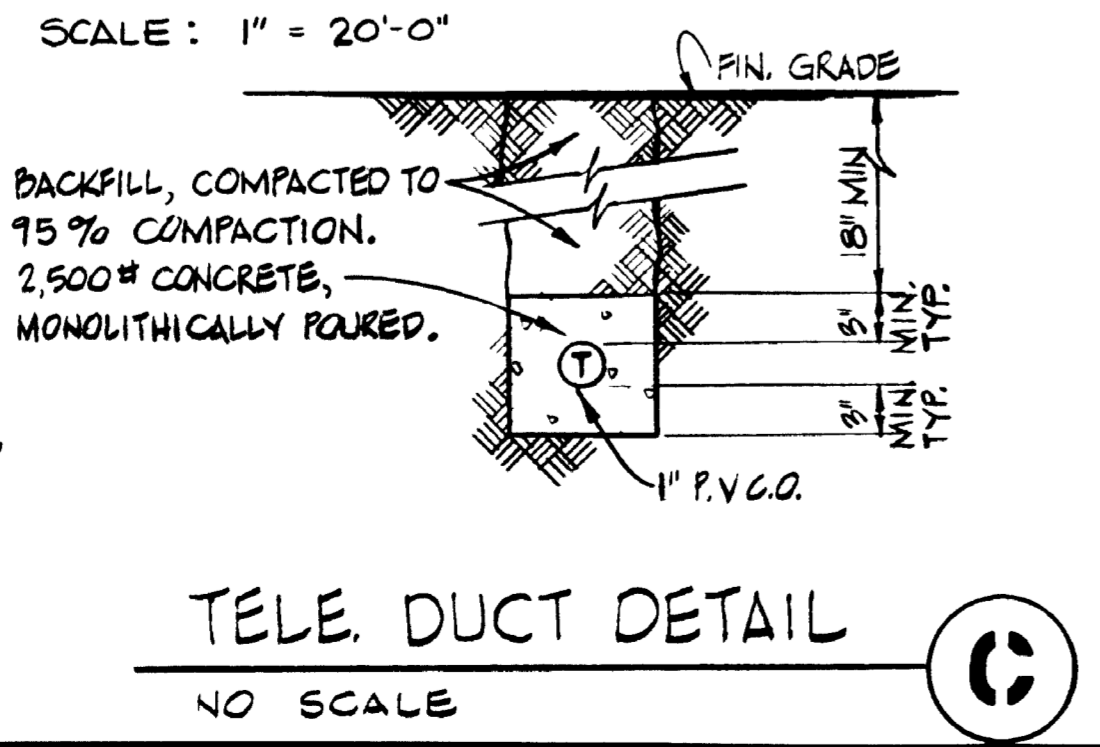
- CEILING OUTLET
- WALL OUTLET
- ⊙ SPOT OR FLOODLIGHT FIXTURE
- ⊙ FAN, CONNECT AS REQUIRED (FRACTIONAL MOTOR AS SHOWN ON PLAN)
- ⊙ JUNCTION BOX, +12" UNLESS NOTED
- ⊙ MOTOR, CONNECT AS REQUIRED (HORSEPOWER INDICATED)
- ⊙ SINGLE POLE FLUSH TOGGLE SWITCH, +48" UNLESS NOTED
- ⊙ MAGNETIC STARTER
- ⊙ EXO SWITCH, NON-FUSED
- ⊙ EXO SWITCH, FUSED
- SWITCHES SHALL BE OF RATING AND NUMBER OF POLES AS REQUIRED
- S_{a,b,c} etc GANGED SWITCHES WITH DESIGNATION OF OUTLETS CONTROLLED
- C_{1,2,3} etc OUTLETS WITH DESIGNATION OF CONTROL SWITCHES
- BRANCH CIRCUIT CONDUIT CONCEALED IN WALL OR CEILING
- - - BRANCH CIRCUIT CONDUIT CONCEALED IN FLOOR OR UNDERGRND
- - - BRANCH CIRCUIT CONDUIT EXPOSED
- ⌒ FLEX CONDUIT
- ANY BRANCH CIRCUIT WITHOUT FURTHER DESIGNATION INDICATES A TWO WIRE CIRCUIT A GREATER QUANTITY OF WIRES IS INDICATED AS FOLLOWS' — (3 WIRES), — (4 WIRES), ETC.
- A-1,3 HOMERUN TO PANELBOARD WITH PANEL AND CIRCUITS DESIGNATED
- 3 CIRCUIT DESIGNATION
- ⊙ DUPLEX CONVENIENCE RECEPTACLE, +12" UNLESS NOTED, COMBINATION TYPE
- P.V.C.O. POLY-VINYL CHLORIDE CONDUIT ONLY (SCHEDULE 40) W/GALV RIGID ELLS & RISERS
- T TELEPHONE CONDUIT ONLY WITH PULL WIRE
- F.D.O. FIBRE DUCT ONLY
- C.O. CONDUIT ONLY
- C/O CONVENIENCE RECEPTACLE
- +24" ETC OUTLET MOUNTING HEIGHT, FINISH FLOOR TO CENTERLINE OF OUTLET
- \$ T MANUAL MOTOR STARTER SWITCH WITH THERMAL OVERLOAD, +48" UNLESS NOTED
- ⊙ 5/8" Ø x 10'-0" COPPER-CLAD GROUND ROD WITH TOP MTD 6" BELOW FINISH GRADE, EXCEPT AS NOTED USE EXOTHERMIC WELDED CONNECTIONS

LIGHTING FIXTURE SCHEDULE

TYPE	MANUFACTURER & CATALOG #	LAMP	MOUNTING	DESCRIPTION
A	SMOOT-HOLMAN #13B16 OR BENJAMIN EQUAL	150W.I.F.	CEILING	16" DIA STANDARD DISCONNECTING DOME INDUSTRIAL INCANDESCENT CEILING MOUNTED FIXTURE. PORCELAIN ENAMEL FINISH.
B	PRESCOLITE #WB-28 W/#WG-B OR HALO EQUAL	150W.I.F.	WALL MOUNT	OPAL GLASS CYLINDER, INCAND. FIXT. WITH SATIN OR BRUSHED ALUMIN. FIN. AND GLOBE GUARD.



ELECTRICAL SITE PLAN



SOLEDAD MOUNTAIN WATER PUMP PLANT

CITY OF SAN DIEGO, CALIFORNIA
UTILITIES DEPARTMENT
SHEET 5 OF 9 SHEETS

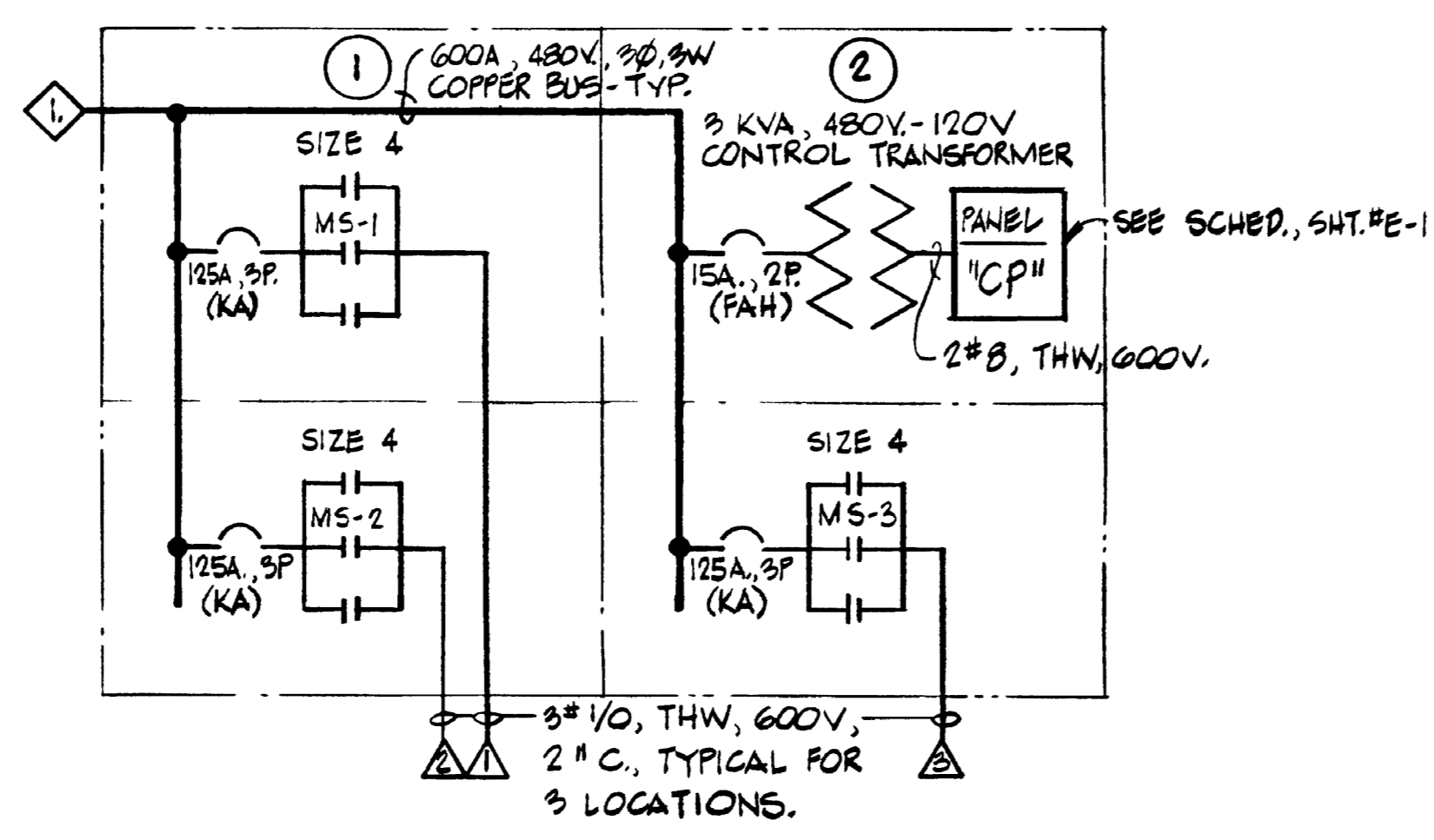
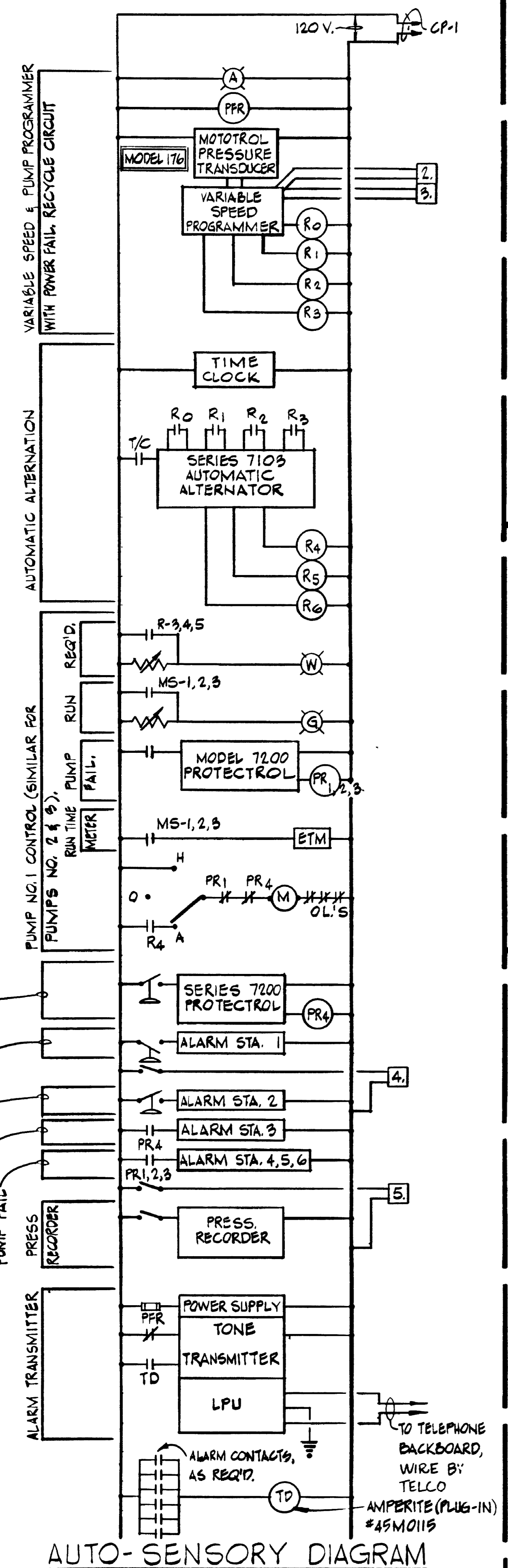
UW 133031
UWO 95571

DATE 8/22/72
ENGINEERING SUPERINTENDENT J. J. ...
DESIGN ENGINEER J. J. ...

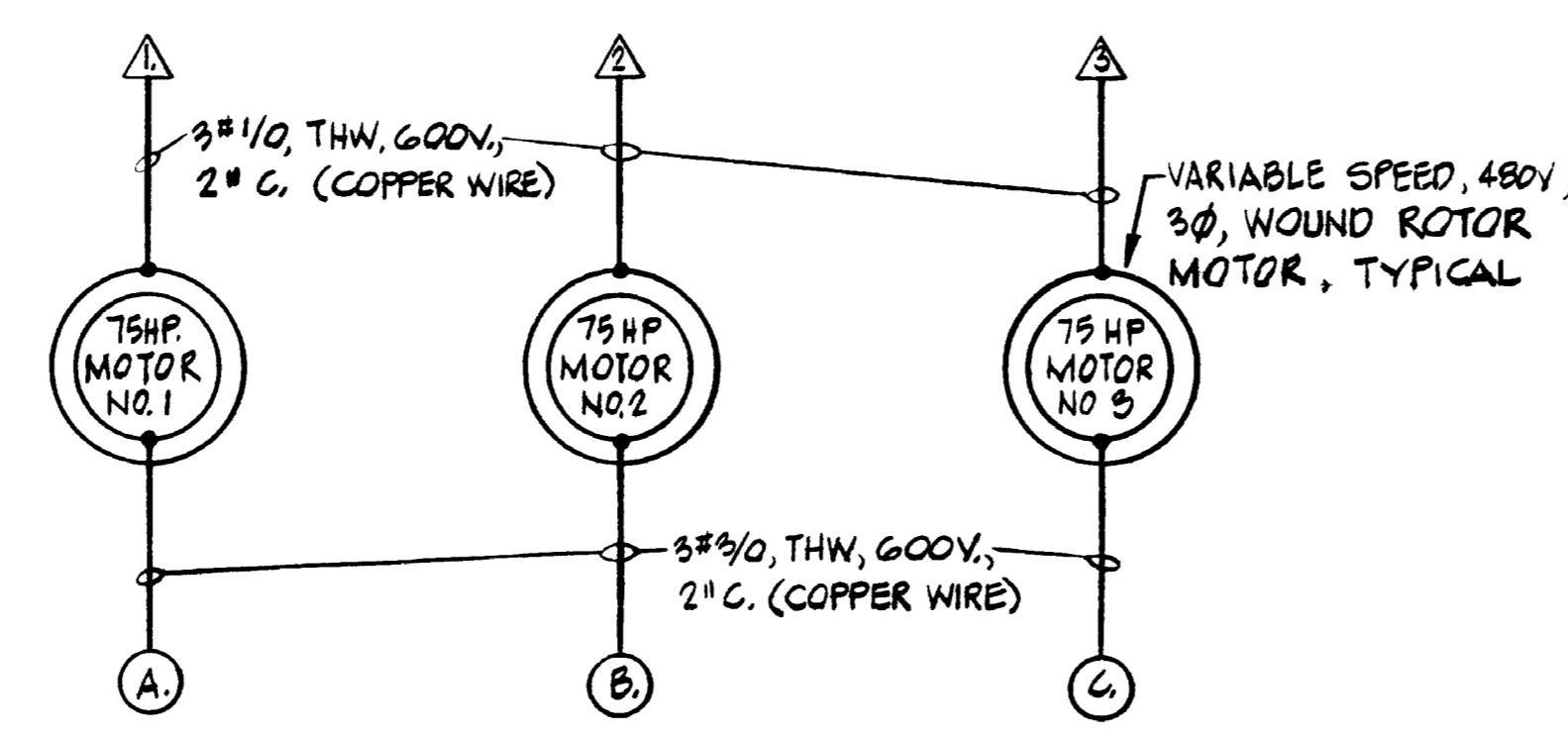
CONTRACTOR: VIEWLAND DATE STARTED 6-21-77
INSPECTOR: BLANKENSHIP DATE COMPLETED 9-15-79
CONNECTIONS BY: ...

CONTROL CERTIFICATION
246-1693
LAMBERT COORDINATES
14853-5 - D

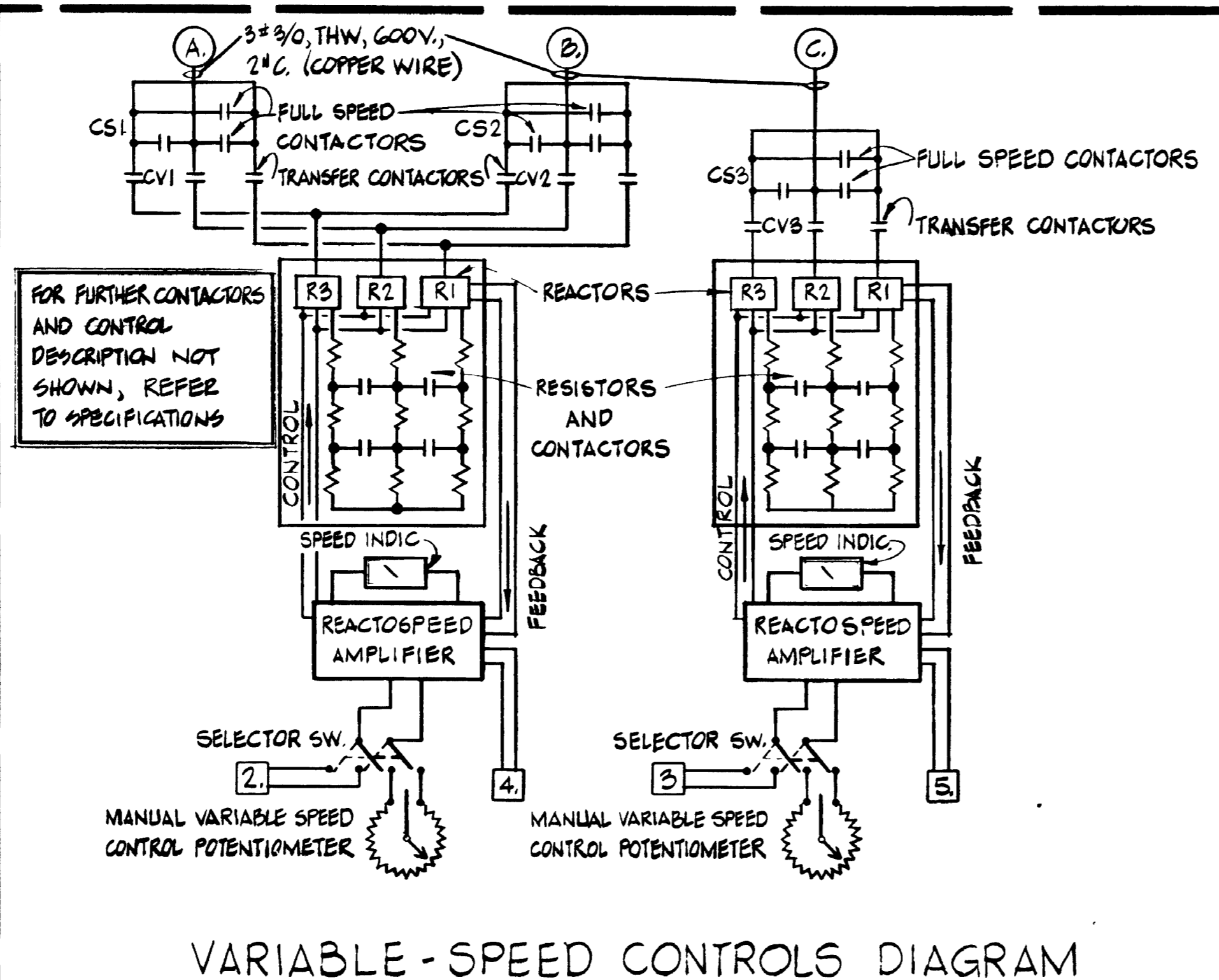
AS-BUILT



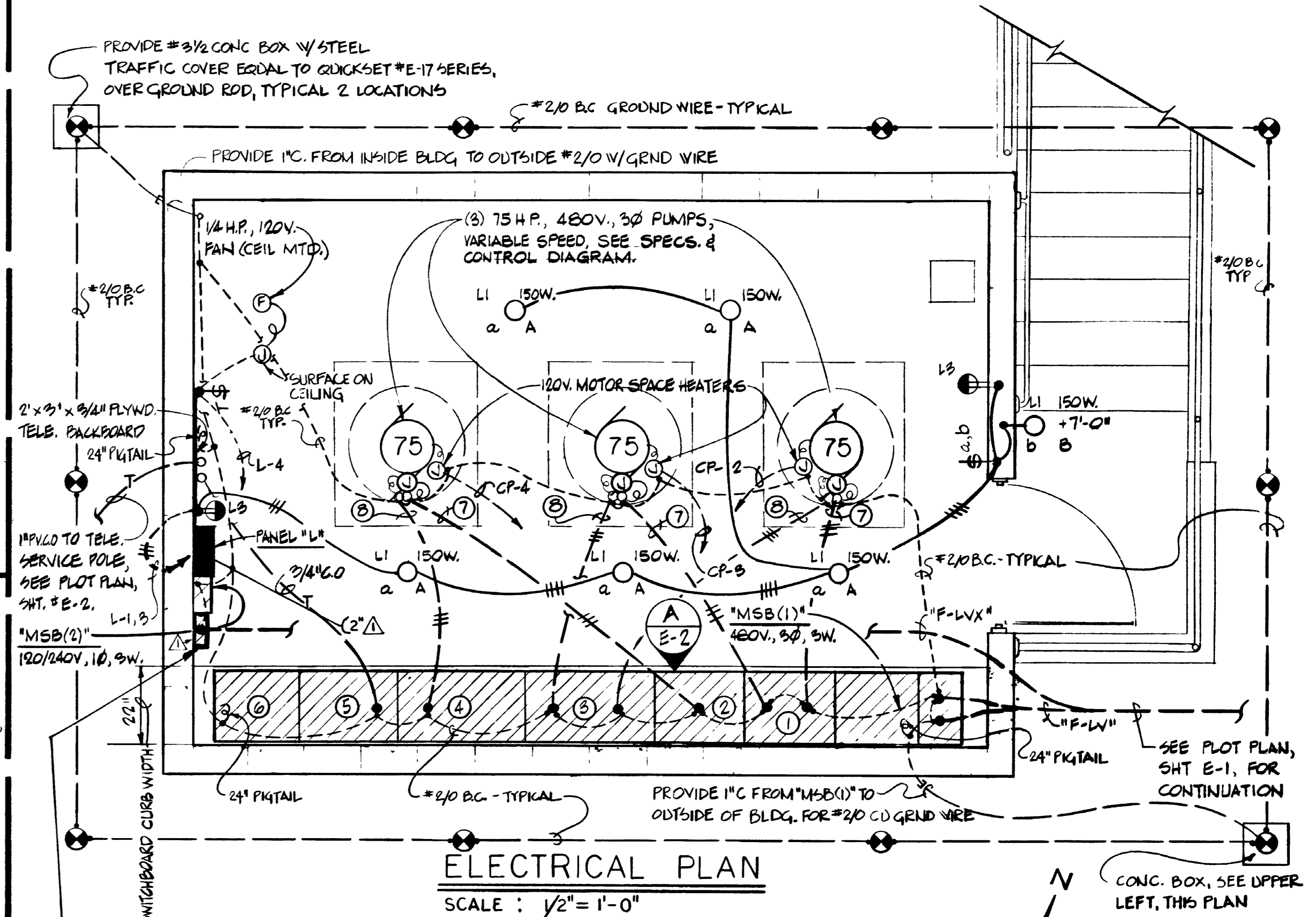
STARTER SECTIONS - SINGLE LINE DIAGRAM



MOTOR CONNECTION - SINGLE LINE DIAGRAM

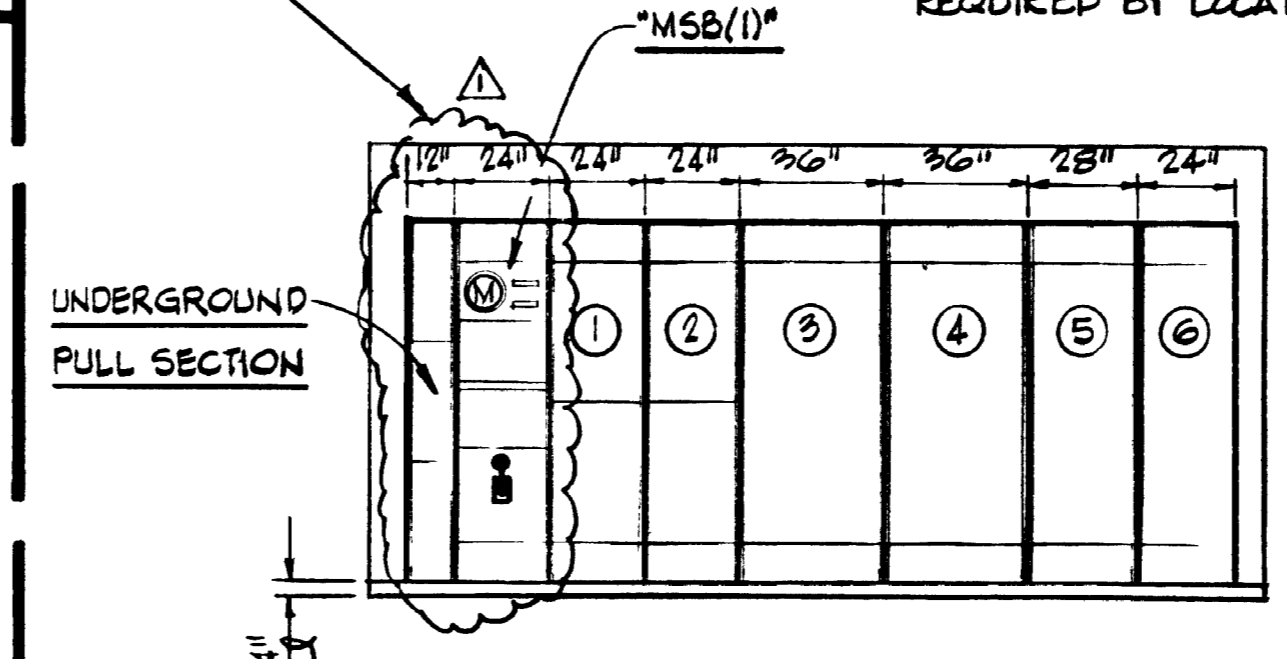


VARIABLE-SPEED CONTROLS DIAGRAM



ELECTRICAL PLAN
SCALE: 1/2" = 1'-0"

NOTE: VERIFY LOCATIONS OF GROUND RODS WITH OTHER UG UTILITIES AND ADJUST LOCATIONS AS REQ'D. MAX. SPACING BETWEEN GROUND RODS SHALL BE 10'-0". PROVIDE ADDITIONAL GROUND RODS AS MAY BE REQUIRED BY LOCATIONS ADJUSTMENTS

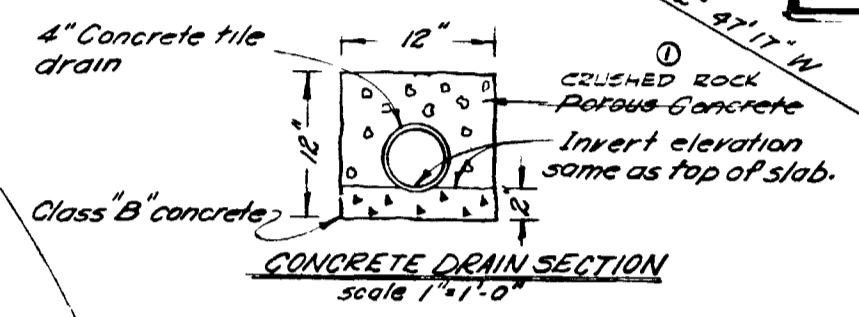
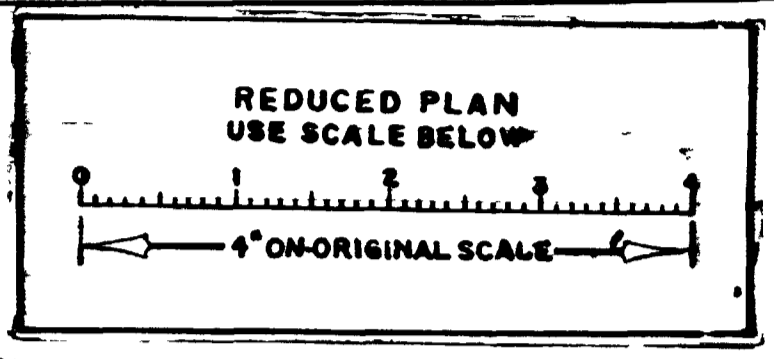
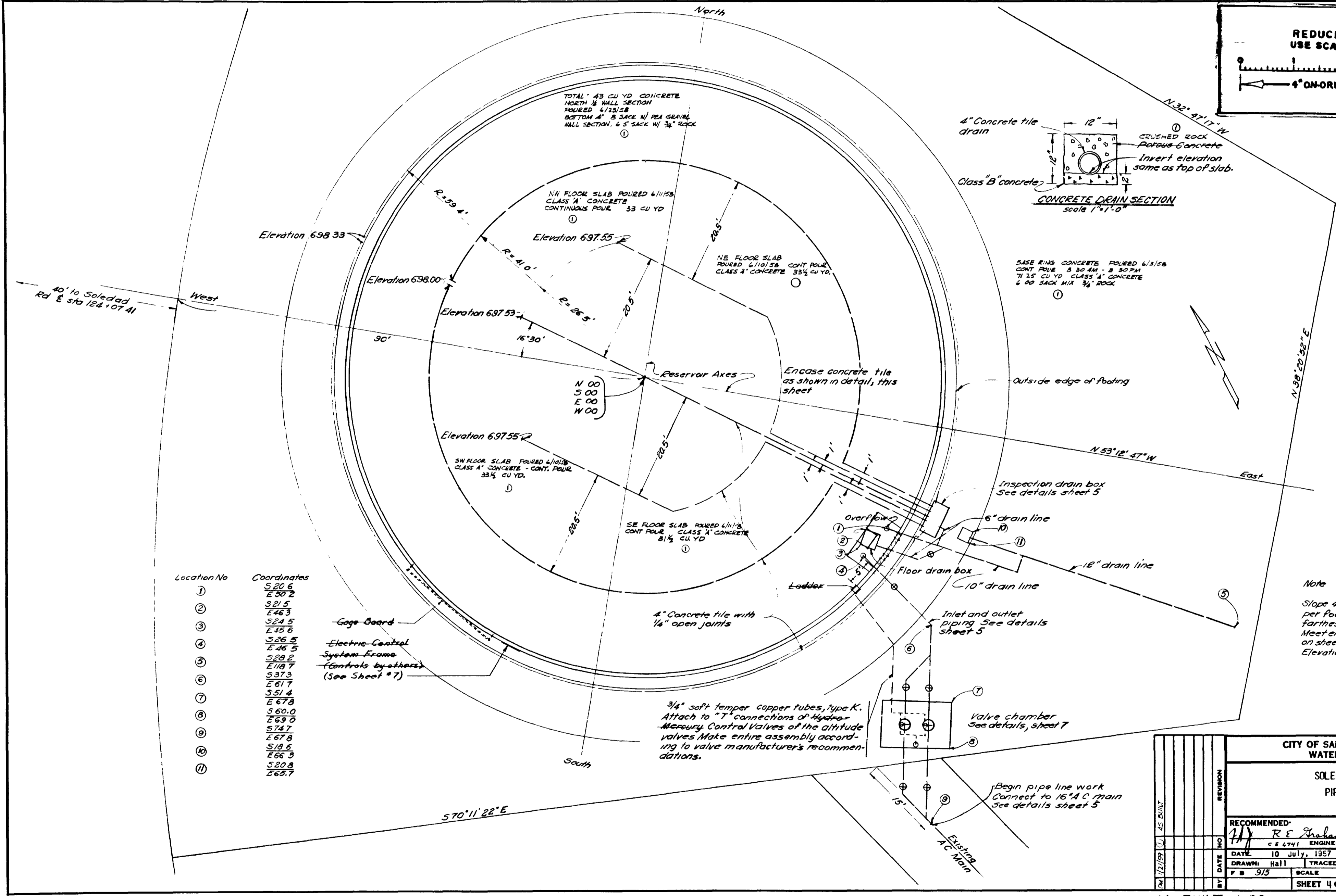


ELEVATION DETAIL A
SCALE: 1/4" = 1'-0"

- NOTES
- 1 MOTOR STARTER SECTION WITH (2) SIZE 4 STARTERS
 - 2 MOTOR STARTER SECTION WITH (1) SIZE 4 STARTER & PANEL "CP"
 - 3 VARIABLE SPEED CONTROL SECTION
 - 4 VARIABLE SPEED CONTROL SECTION
 - 5 AUTO-SENSORY SECTION
 - 6 AUTO-SENSORY SECTION
 - 7 3#1/0, CU, THW, 600V., 2" C.
 - 8 3#3/0, CU, THW, 600V., 2" C.

SOLEDAD MOUNTAIN WATER PUMP PLANT			
CITY OF SAN DIEGO, CALIFORNIA UTILITIES DEPARTMENT SHEET 6 OF 9 SHEETS		UWO 133031 UWO 95571	
UTILITIES DIRECTOR		DATE 8/29/72	ENGINEERING SUPERINTENDENT
DESCRIPTION	BY	APPROVED	FILED
ORIGINAL	GIL	[Signature]	8/31/72
AS-BUILT	J.E.C.	[Signature]	9/15/78
CONSTRUCTION RECORD			CONTROL CERTIFICATION
CONTRACTOR: VEWLAND		DATE STARTED: 6-21-77	246-1693
INSPECTOR: BLANKENSHIP		DATE COMPLETED: 9-15-78	LAMBERT COORDINATES
CONNECTIONS BY:			14853-6-D

AS-BUILT



Location No	Coordinates
1	S 20.6
2	E 30.2
3	S 21.5
4	E 46.3
5	S 24.5
6	E 45.6
7	S 26.5
8	E 46.5
9	S 28.2
10	E 48.7
11	S 37.3
12	E 61.7
13	S 31.4
14	E 67.8
15	S 60.0
16	E 69.0
17	S 74.7
18	E 67.8
19	S 18.6
20	E 66.9
21	S 20.8
22	E 63.7

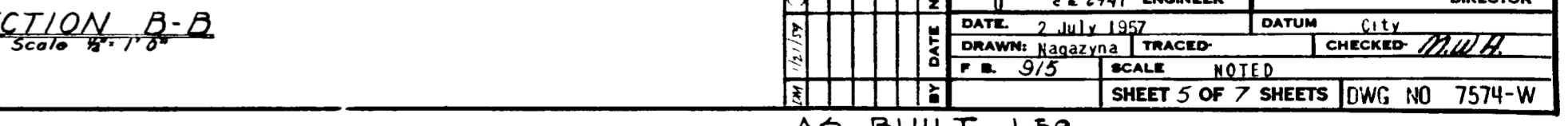
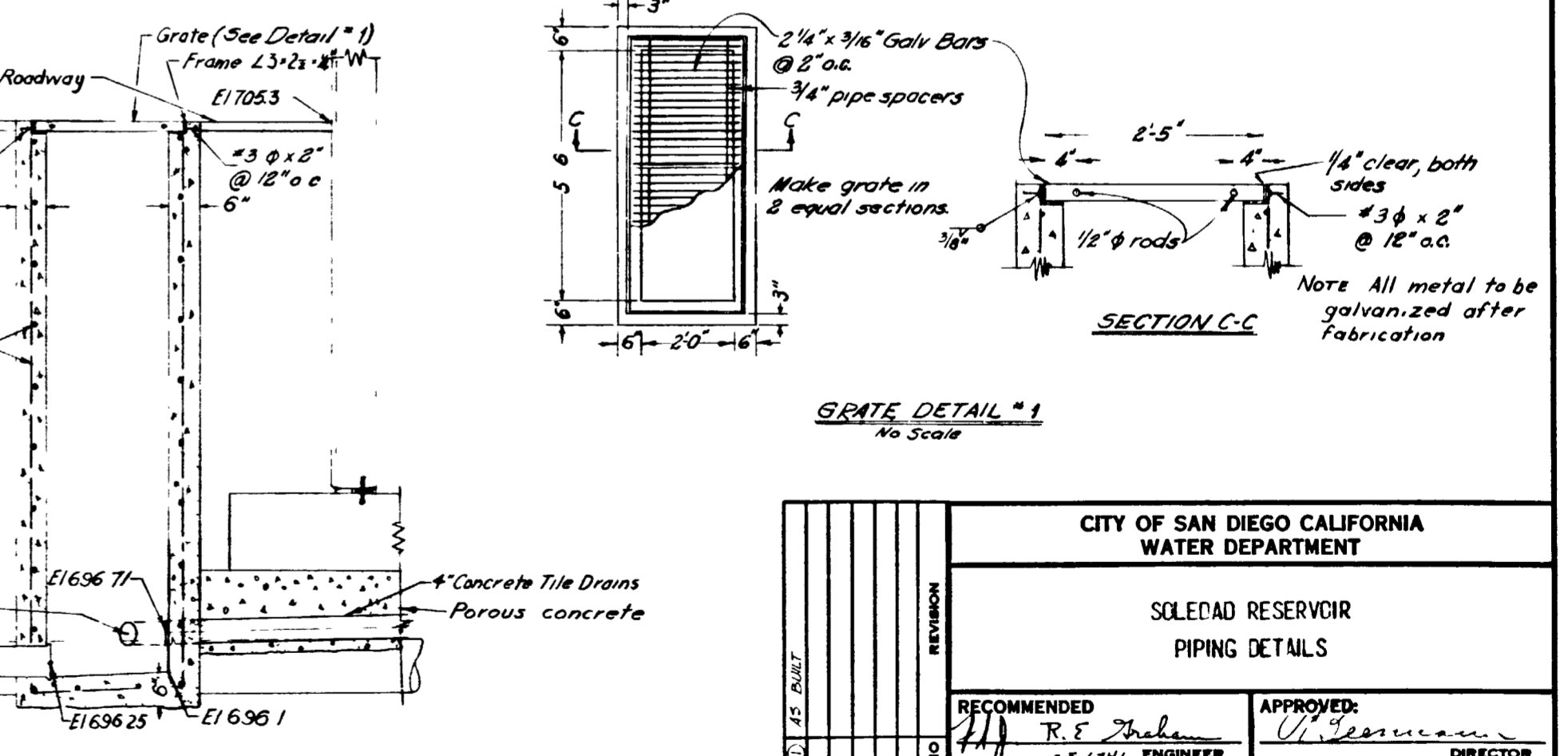
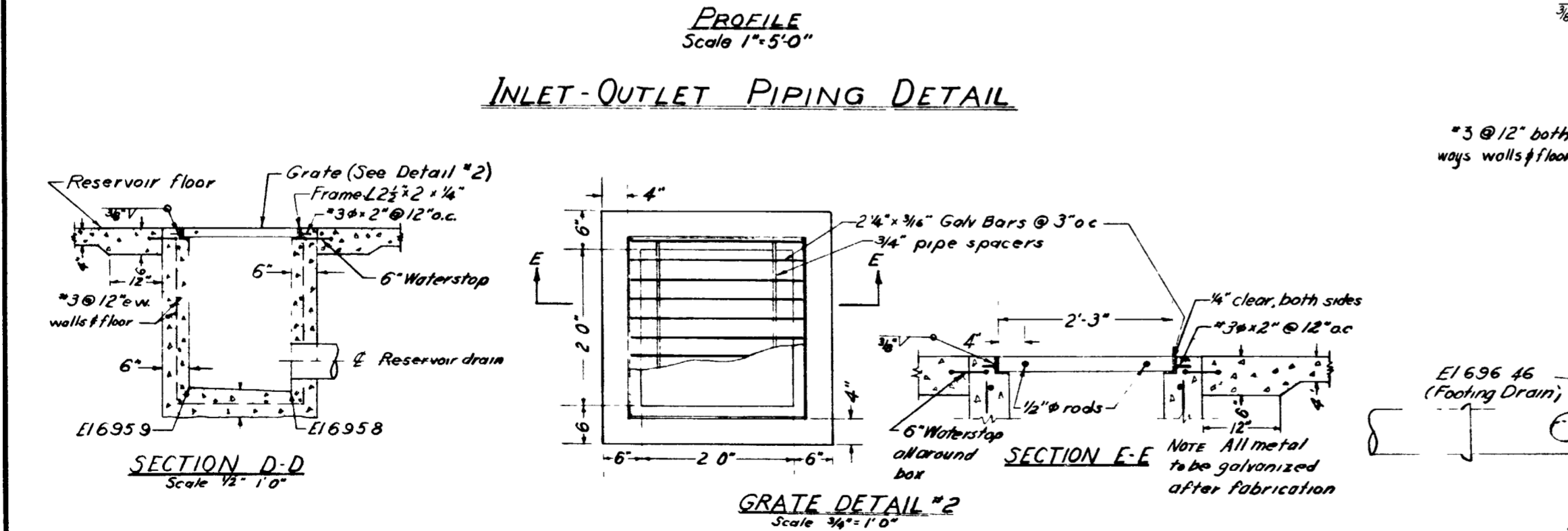
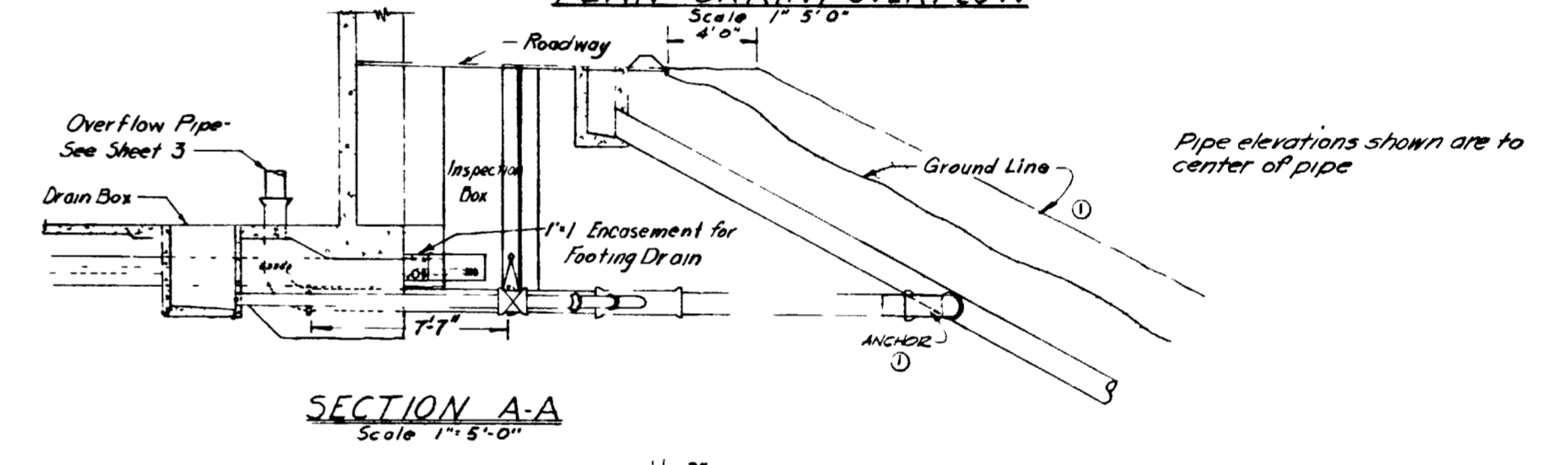
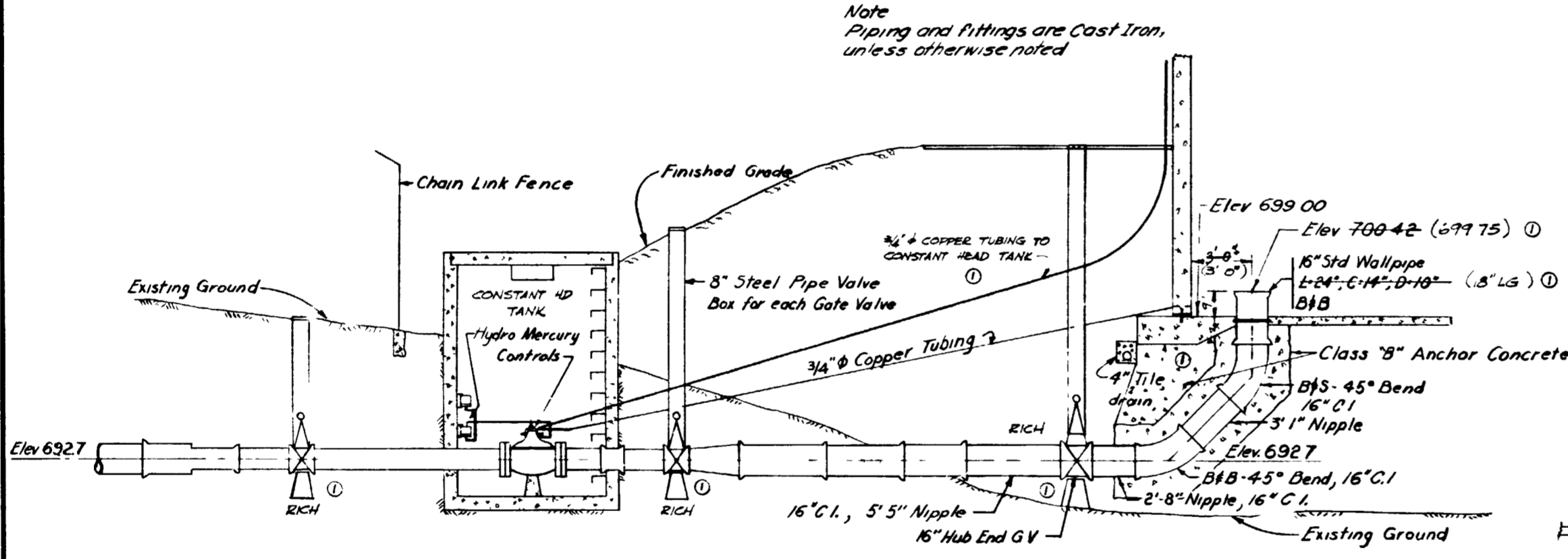
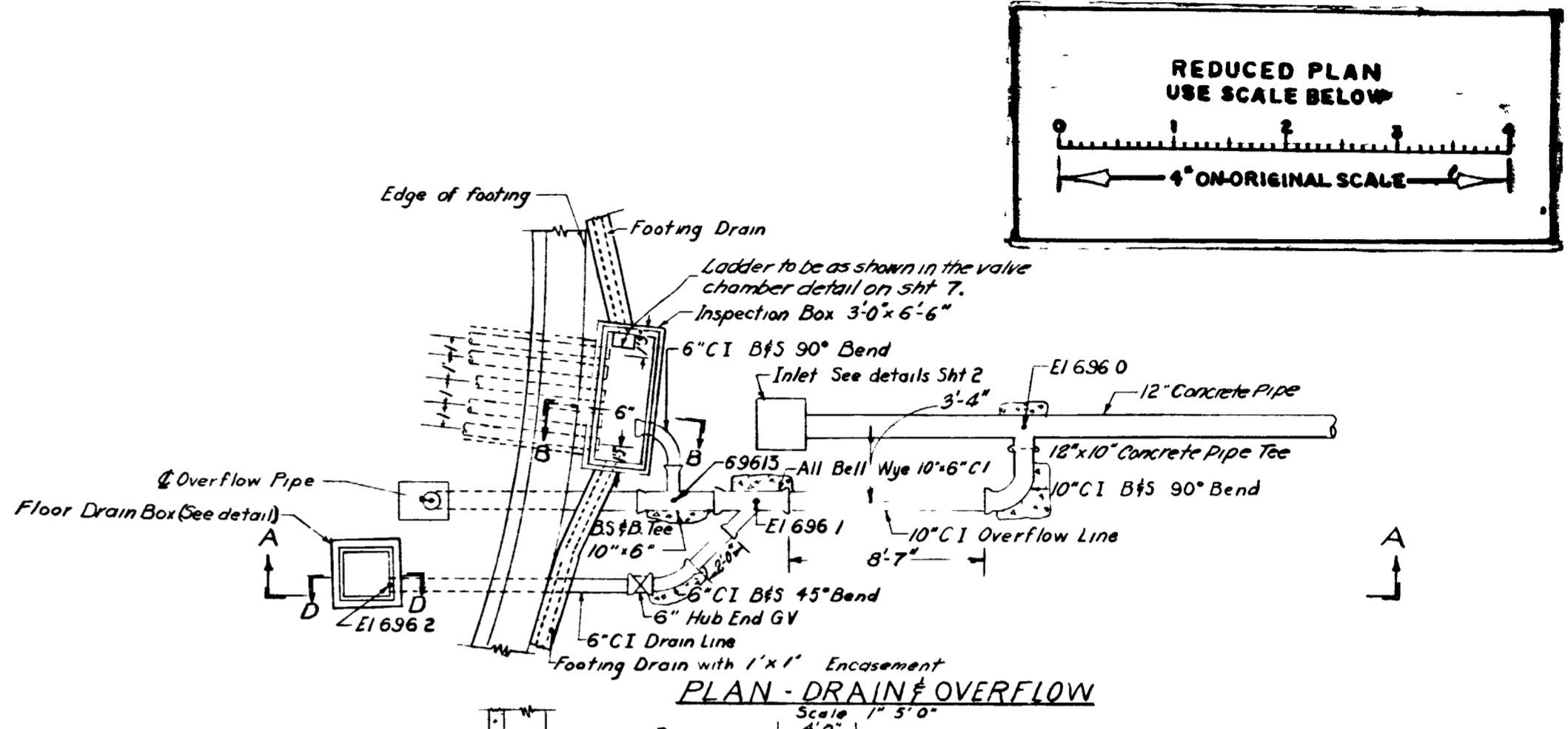
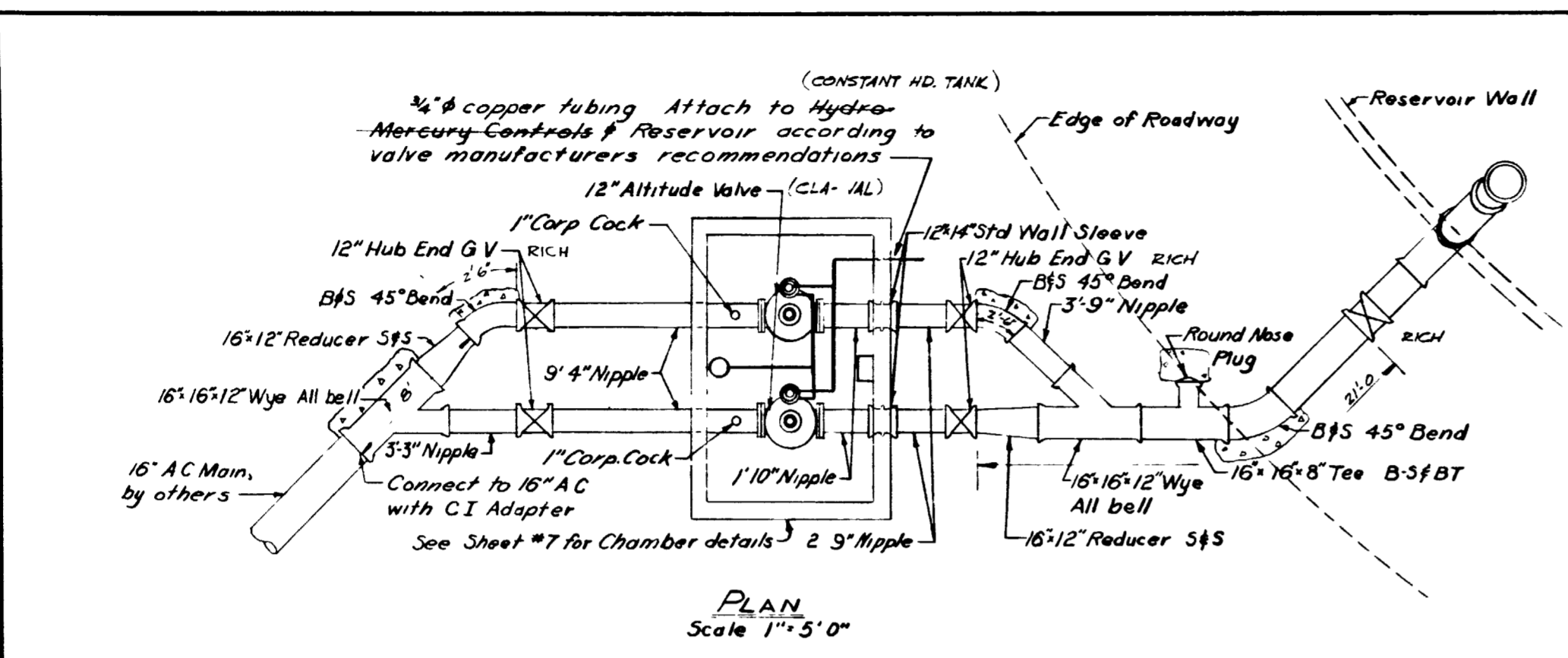
Gage Board
 Electric Control System Frame (Controls by others) (See Sheet #7)

3/4\"/>

Note
 Slope 4\"/>

CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT	
SOLEDAD RESERVOIR PIPING LAYOUT	
RECOMMENDED: <i>H. R. E. [Signature]</i> C. E. 6741 ENGINEER	APPROVED: <i>[Signature]</i> DIRECTOR
DATE: 10 July, 1957	DATUM: City
DRAWN: Hall	TRACED: [Signature]
P. B. 9/5	CHECKED: <i>M. H. [Signature]</i>
SCALE: 1" = 10' & Noted	SHEET 4 OF 7 SHEETS
7574-W	

AS BUILT 1-59
 MICROFILMED
 JAN 23 1964



REVISION		CITY OF SAN DIEGO CALIFORNIA WATER DEPARTMENT	
		SOLEDAD RESERVOIR PIPING DETAILS	
RECOMMENDED	APPROVED:		
<i>R.E. Thaler</i>	<i>[Signature]</i>		
DATE: 2 July 1957	DATUM: City		
DRAWN: Nagayzyna	TRACED: [initials]		
P. B. 9/5	SCALE: NOTED		
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APPENDIX L
LEAD AND ASBESTOS ABATEMENT REPORT



THE CITY OF SAN DIEGO

ENVIRONMENTAL
SERVICES DEPARTMENT



LEAD CONTAINING MATERIALS
ABATEMENT SPECIFICATION
for
SOLEDAD PUMP STATION UPGRADES
JANUARY 05, 2017

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I. GENERAL REQUIREMENTS

A. DESCRIPTION OF WORK

1. ABATEMENT CONTRACTOR shall supply all labor, transportation, material, apparatus, and equipment for the removal, and disposal of lead containing materials to be impacted as a result of this project, as identified in Appendix C of this section.
2. ABATEMENT CONTRACTOR shall be responsible for ensuring the surrounding areas will not be contaminated with lead containing materials during work and shall be responsible for any clean-up determined necessary by City of San Diego's PROJECT MONITOR.
3. Before submitting his/her bid, the ABATEMENT CONTRACTOR shall visit the project site and verify the location of the lead containing materials that will be removed under the terms and conditions of the contract and this specification.
4. All paint chips collected must be stored in sealable drum containers (not in bags).
5. Abatement work shall be performed within agreed upon hours submitted prior to project start which will not include designated City holidays.
6. Before the beginning of abatement work the ABATEMENT CONTRACTOR shall hold a safety construction meeting with all abatement supervisors, workers, and other contractors on-site that provides an overview of the accepted work plan, decontamination procedures specific to this project (decontamination procedures shall be on paper with copies for all present), and disposal plan for this project. Meeting shall include the PROJECT MONITOR and any other designated City representative.

B. CONTRACTOR USE OF THE PREMISES

1. All site rules and regulations affecting the work should be complied with while engaged in project activities. The existing building should be maintained in a safe condition throughout the abatement activities. The ABATEMENT CONTRACTOR will be responsible for adhering to all applicable building codes and fire safety requirements.
2. All public areas will be kept free of accumulated waste, materials, rubbish, and debris.

C. PROJECT COORDINATION

1. It will be the responsibility of the ABATEMENT CONTRACTOR to coordinate all site activities with the City's Asbestos & Lead Management Program's (ALMP) PROJECT MONITOR including any meetings, surveys, special reports, and site usage limitations.

D. PROJECT SUBMITTALS

The ABATEMENT CONTRACTOR shall not commence any work until approval has been given from the City. The ABATEMENT CONTRACTOR shall submit the following at least 30 days prior to commencement of any lead abatement activities:

1. Lead Abatement Work Plan:
 - a) Submit a detailed job-specific plan that includes:
 - (1) The procedures proposed to comply with the requirements of this specification and all applicable regulations.
 - (2) Detailed drawings that identify the location, size, layout and details of the Work Areas, any equipment, disposal storage, restrooms, and worker decontamination facilities.
 - (3) The sequencing of abatement work and the interface of trades involved in the performance of work. Provide a time line that details each major phase of work activity and anticipated time it will occur.
 - (4) The methods to be used to assure the safety of occupants and visitors to the site.
 - (5) A description of methods to be used to control dispersion of hazardous materials to the interior and exterior of the building.
 - (6) The method of removal to minimize dust generation in the Work Area.
 - b) Work site coordination submittals including:
 - (1) Contingency and Spill Plan: Prepare a contingency plan for emergencies including fire, accident, power failure, or any other event that may require modification or abridgement of decontamination or Work Area isolation procedures. Include in plan specific procedures for decontamination or Work Area isolation. Plan should be specific for all types of hazardous materials or situations specific to this work site. Note that nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency.
 - (2) Telephone numbers and locations of emergency services including but not limited to fire, ambulance, doctor, hospital, police, power company, telephone company.
2. Notifications:
 - a) Prior to any abatement activities the ABATEMENT CONTRACTOR must submit a CDPH Form 8551 (Abatement of Lead Hazards Notification) to the Compliance and Enforcement Unit of the CLPPB. The Form 8551 must be

posted at the entrances to the property at least 5 days prior and during abatement activities.

b) Submit Cal/OSHA pre-job notification for lead-related construction work per Title 8 CCR 1532.1 subsection (p), "Lead-Work Pre-Job Notification".

c) Permits, notifications, and licenses needed to perform work (including hazardous waste hauler's registration)

d) Notify emergency service agencies including fire, ambulance, police or other agency that may service the abatement work site in case of an emergency. Notification is to include methods of entering Work Area, emergency entry and exit locations, modifications to fire notification or fire-fighting equipment, and other information needed by agencies providing emergency services.

e) Notifications of Emergency: Any individual at the job site may notify emergency service agencies if necessary without effect on this contract or the Contract Sum.

f) Provide submittal identifying person responsible for responding to project site emergencies twenty-four hours a day, seven days a week.

3. ABATEMENT CONTRACTOR qualifications and personnel information submittals that include but are not limited to:

a) Provide all staff names, certifications, and experience. Identify their duties and responsibilities on this project. ABATEMENT CONTRACTOR shall have the following minimum levels of qualified supervision on the project site:

(1) General Superintendent: Provide a full-time General Superintendent who is experienced in administration and supervision of lead abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. This person is the ABATEMENT CONTRACTOR's representative responsible for compliance with all applicable federal, state and local regulations and guidelines, particularly those relating to lead abatement and hazardous waste. Should, in the opinion of the OWNER, any language barrier exist between the on-site superintendent and the OWNER or PROJECT MONITOR, the ABATEMENT CONTRACTOR shall employ a qualified full-time interpreter or provide a new on-site superintendent at no additional cost to the OWNER. Shall be CDPH certified as a Lead Supervisor.

(2) Foreman: Provide a full time Foreman to directly supervise and direct no more than 10 lead workers. Each Foreman will act as the Competent Person for the workers the foreman is directing. The Foreman has oversight authority over the workers and reports to the General Superintendent. If there are 10 or fewer abatement workers

on the project the General Superintendent may fill the Foreman's position. Shall be CDPH certified as a Lead Supervisor.

(3) Experience and Training: The General Superintendent and foreman shall meet all the training requirements as a Supervisor in accordance with Title 17, California Code of Regulations, Division 1, Chapter 8. They shall also have experience with projects of similar types and sizes.

(4) Workers: All abatement workers shall have current certifications as a Lead Worker in accordance with Title 17, California Code of Regulations, Division 1, Chapter 8.

(5) Certificate of Worker's Acknowledgment: Submit an original signed copy of the Certificate of Worker's Acknowledgment found in Appendix A of this section, for each worker and supervisor who is to be at the job site or enter the Work Area.

b) Identify state licensed transporter, disposal location, and associated permits for all hazardous waste.

c) Submit respiratory protection information and air monitoring data as per the following:

(1) Operating Instruction: Submit complete operating and maintenance instructions for all components and systems as a whole. Submittal is to be in bound manual form suitable for field use.

(2) Respiratory Protection Program: Submit ABATEMENT CONTRACTOR's written respiratory protection program manual as required by 8 CCR 1531 and 5144.

(3) Respiratory Protection Schedule: Submit level of respiratory protection intended for each operation required by the project.

(4) Copies of current respirator fit test: Fit tests must be performed every 6 months.

d) Submit doctor's report from medical examination conducted within the last 12 months as part of compliance with OSHA medical surveillance requirements for each worker who is to enter the Work Area. Submit, at a minimum, the following for each worker:

(1) Name and Social Security Number

(2) Copies of Blood Lead Levels and Zinc Protoporphyrin tests

(3) Physicians Written Opinion from examining physician including at a minimum the following:

- (a) Whether worker has any detected medical conditions that would place the worker at an increased risk of material health impairment from exposure to lead. Any recommended limitations on the worker or on the use of personal protective equipment such as respirators.
 - (b) Statement that the worker has been informed by the physician of the results of the medical examination and of any medical conditions that may result from lead exposure.
 - e) Submit a notarized certification, signed by an officer of the ABATEMENT CONTRACTOR firm that exposure measurements, medical surveillance, and worker training records are being kept in conformance with 8 CCR 1529.
 - f) Identify the laboratory that will be performing the analysis of the personal samples and provide their accreditation. Also discuss the method by which the ABATEMENT CONTRACTOR will provide the analytical results to the PROJECT MONITOR within 24 hours of sampling completion.
- 4. Submit the following during and at the completion of the work
 - a) Copies of all Waste Shipment Records
 - b) Copies of all air monitoring results within 24 hours
- 5. At the end of a project, the ABATEMENT CONTRACTOR shall submit the following to the PROJECT MONITOR:
 - a) Personal Air Sample Results
 - b) Copies of Project Daily Logs
 - c) Containment Entry/Exit Logs
 - d) Waste Disposal Documentation
 - e) Certificate of Visual Inspection

E. SCHEDULES AND REPORTS

- 1. Prior to each phase of project, the ABATEMENT CONTRACTOR shall provide the City with a tentative time line which outlines the project schedule. These documents will be reviewed and approved by the City prior to the commencement of work.

F. PRODUCT DATA

- 1. The ABATEMENT CONTRACTOR shall submit product information that is to be used during the abatement activities prior to commencement of work (i.e., encapsulants). General information required includes manufacturer's standard printed recommendations for application and use, compliance with recognized standards of trade association and testing agencies, and safety data sheets (SDSs).
- 2. Polyethylene sheet

a) A single polyethylene film in the largest sheet size possible to minimize seams, 4.0 or 6.0 mil thick as indicated, and clear, frosted, or black as indicated.

b) Provide flame resistant polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 4.0 or 6.0 mil thick as indicated, and frosted or black as indicated.

c) Reinforced Polyethylene Sheet: Where plastic sheet is the only separation between the Work Area and building exterior, provide translucent, nylon reinforced, laminated, flame resistant, polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 4.0 or 6.0 mil thick as indicated, frosted or black as indicated.

3. Tape

a) Provide duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to stick aggressively to sheet polyethylene.

4. Spray adhesive

a) Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

G. PROJECT CLOSE-OUT

1. Upon completion of work and prior to payment, the PROJECT MONITOR will proceed with an initial inspection of the abatement work area. A Certificate of Visual Inspection (Appendix B) will be signed by both the ABATEMENT CONTRACTOR and PROJECT MONITOR. The ABATEMENT CONTRACTOR will not be paid until the area meets the established project-specific clearance criteria and has submitted the required information.

II. DEFINITIONS

A. ABATEMENT: Any set of measures designed to permanently eliminate lead based paint hazards including paint removal, building component removal, or near-permanent enclosure of lead based paint hazards.

B. ABATEMENT CONTRACTOR: The designated sub-contractor performing the required abatement work outlined in this specification.

C. ACCREDITED or ACCREDITATION (when referring to a person or laboratory): A person or laboratory accredited in accordance with section 206 of Title II of the Toxic Substances Control Act (TSCA).

D. ACTION LEVEL: An 8-hour time weighted average (TWA) lead airborne concentration of 30 µg/m³.

- E. AIR MONITORING: The process of measuring the lead content of a specific volume of air.
- F. AUTHORIZED VISITOR: The Owner, the Owner's Representative, testing lab personnel, the Architect/Engineer, emergency personnel or a representative of any federal, state and local regulatory or other agency having authority over the project.
- G. BARRIER: Any surface that seals off the work area to inhibit the movement of dust.
- H. BREATHING ZONE: A hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches.
- I. CONTAINMENT: A process for protecting both workers and environment by controlling exposures to lead dust and debris created during abatement.
- J. CONTAMINATE: Refers to lead-containing dust/debris.
- K. DEMOLITION: The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.
- L. DISPOSAL BAG: A properly labeled 6 mil thick leak tight plastic bags used for transporting lead waste from work site to disposal site.
- M. ENCAPSULATION: Any covering or coating that acts as a barrier between lead based paint and the environment and that relies on adhesion and the integrity of the existing paint bonds between layers and with the substrate for its durability.
- N. ENCLOSURE: The use of rigid durable construction materials that are mechanically fastened to the substrate in order to act as a barrier between lead based paint and the living or work space.
- O. HEPA FILTER: A high Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97% of all mono-dispersed particles greater than 0.3 microns in diameter or larger.
- P. HEPA FILTER VACUUM COLLECTION EQUIPMENT (or vacuum cleaner): High efficiency particulate air filtered vacuum collection equipment with a filter system capable of collecting and retaining lead.
- Q. HIGH PHOSPHATE DETERGENT: Detergent which contains at least 5% tri sodium phosphate.
- R. LEAD: Means metallic lead, all inorganic lead compounds, and organic lead soaps.
- S. LEAD-BASED PAINT (LBP): For purposes of this project, LBP refers to the materials identified in these specifications as having paint or coatings that contains lead.
- T. LEAD-RELATED CONSTRUCTION SUPERVISOR: Means an individual who is responsible for implementing lead-related construction work and enforcing work practices. This person must have received certification as a lead-related construction Supervisor.

- U. LEAD-RELATED CONSTRUCTION WORK: Means any construction, alteration, painting, demolition, salvage, renovation, repair, or maintenance of a building, including preparation and cleanup, by disturbing lead-containing material that may result in exposure of individuals to lead.
- V. LEAD-RELATED CONSTRUCTION WORKER: Means any individual who performs lead-related construction work in a building under the direction of lead-related construction Supervisor, and has received certification as a lead-related construction Worker.
- W. OWNER: Refers to the City of San Diego
- X. PAINT FILM STABILIZATION: The process of using wet scraping, priming, and repainting a deteriorated lead based paint film in a dwelling including clean-up and clearance.
- Y. PAINT REMOVAL: A strategy of abatement which entails removing lead based paint from surfaces of components using chemicals, heat guns below 11000F, and certain contained abrasive methods but not open flame burning, open abrasive blasting, sandblasting, water blasting, extensive dry scraping, or methylene chloride removers.
- Z. PERMISSIBLE EXPOSURE LIMIT (PEL): An 8-hour TWA lead airborne concentration of 50 µg/m³.
- AA. PERSONAL MONITORING: Sampling of contaminant concentrations within the breathing zone of an employee.
- BB. PROJECT MONITOR: City of San Diego Asbestos & Lead Management Program staff or their designated consultant.
- CC. PROTECTION FACTOR: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.
- DD. RRP: EPA's Renovation, Repair and Painting certification that requires contractor training and lead-safe work practices when performing renovation type activities in housing built prior to 1978.
- EE. REPLACEMENT: A strategy of abatement which entails the removal of components such as windows, doors, and trim that have lead painted surfaces and installing new components free of lead paint.
- FF. RESPIRATOR: A device designed to protect the wearer from the inhalation of harmful contaminants.

- GG. TESTING LABORATORIES: A “testing laboratory” is an entity engaged to perform specific inspections or tests (either at the project site or elsewhere), and to report on, and if required, to interpret results of those inspections or tests.
- HH. TIME-WEIGHTED AVERAGE (TWA): The average concentration of a contaminant in air during a specific time period.
- II. TRIGGER TASKS: Work tasks that require an employer to assume specified employee exposures until the employer has performed an exposure assessment [see T8CCr, 1532.1 (d) (2)].
- JJ. WET CLEANING: The process of eliminating lead contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of appropriately.
- KK. WORK AREA: The area where abatement work operations are performed which is defined and/or isolated to prevent the spread of contamination, and entry by unauthorized personnel.

III. SITE WORK

A. INTRODUCTION

This portion of the specification describes procedures and protocols for abatement activities. The protocols/procedures described hereafter are in accordance with federal/state/local requirements. In the absence of these requirements, the procedure/protocols are based on current industry standards.

B. BACKGROUND INFORMATION

Sampling of building materials has been performed by inspectors from the City's Asbestos and Lead Management Program (ALMP) and has been provided in Appendix C of this specification. The ABATEMENT CONTRACTOR shall visit the project site and verify the location and quantities of the lead containing materials that will be removed under the terms and conditions of the contract and this specification

C. GENERAL INFORMATION

1. Potential Hazards

- a) The disturbance of lead containing materials may cause exposure to workers and building occupants. All workers, supervisory personnel, subcontractors, and consultants who will be at the job site, need to be apprised of the seriousness of the hazard and of proper work practices which must be followed to minimize exposure. The procedures and methods described herein must be followed and the ABATEMENT CONTRACTOR must comply with all applicable federal/state/local requirements.

2. Stop Work

- a) If the PROJECT MONITOR presents a verbal or written stop work order, the ABATEMENT CONTRACTOR shall immediately and automatically stop all work. Recommencement of the work may not begin until authorized by the PROJECT MONITOR.

D. PROJECT ADMINISTRATION

1. Certified Supervisor

The ABATEMENT CONTRACTOR needs to provide a full-time lead abatement supervisor who is experienced in administration and supervision of lead abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. This supervisor must have a current CDPH Lead Supervisor certificate. This person will act as the competent person on the job.

In addition, all employees working on the project must have current CDPH Lead Worker certification.

E. SPECIAL REPORTS

1. Reporting Unusual Events

When an event of unusual and significant nature occurs at the site (e.g., a spill of lead debris, failure of special equipment used to contain lead), the ABATEMENT CONTRACTOR shall prepare and submit a special report listing the chain of events, persons participating, response by Contractor's personnel, evaluation of results, and other pertinent information.

2. Reporting Accidents

The ABATEMENT CONTRACTOR shall prepare and submit reports of significant accidents at the subject site. Pertinent data and actions need to be recorded. In addition, response actions should comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury or potential environmental contamination.

F. COMPLIANCE WITH CODES AND REGULATIONS

1. Except to the extent that more explicit, or more stringent requirements are written directly into this Abatement Contract/Specification, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.

2. The ABATEMENT CONTRACTOR will assume full responsibility and liability for the compliance with all applicable federal/state/local regulations pertaining to work practices, protection of workers, and visitors to the site, persons occupying areas adjacent to the site, hauling, and disposal of waste. The ABATEMENT CONTRACTOR shall hold the City and its representative harmless for the ABATEMENT CONTRACTOR's failure to comply with any applicable work, hauling, disposal, safety, health, or other regulation on the part of itself, its employees, or its subcontractors,

3. State requirements which govern lead hazard control activities or hauling and disposal of hazardous waste include, but are not limited to, the following:

a) California Occupational Safety and Health Administration (Cal/OSHA):

- (1) Division of Industrial Safety; Chapter 4
- (2) 8CCR, Section 1532.1, Lead in Construction
- (3) 8CCR, Section 5194, Hazard Communication Standard
- (4) 8CCR, Section 1531, Construction Respiratory Protection Standard
- (5) 8CCR, Section 1514, Construction Personal Protective Equipment
- (6) 8CCR, Section 1509, Construction Injury Illness Prevention Program
- (7) 8CCR, Section 6003-4, Accident Prevention Signs and Tags
- (8) 8CCR, Section 3204, Access to Employee Exposure Medical Records

b) California Environmental Protection Agency (Cal/EPA):

- (1) 22CCR, Division 4.5, Environmental Health Standards for the Management of Hazardous Waste.

c) California Department of Public Health (CDPH):

- (1) 17CCR, Division 1, Chapter 8, Accreditation of training providers and interim certification of individuals engaged in lead-related construction work.

4. Federal requirements which govern lead hazard control activities or hauling and disposal of hazardous waste include, but are not limited to, the following:

a) Federal Environmental Protection Agency (FED/EPA):

- (1) Hazardous Waste Standards, 40 Code of Federal Regulations (CFR), Part 261
- (2) EPA Renovate, Repair, Painting (RRP), 40 CFR 745, Subpart E.

b) U.S. Department of Transportation (DOT):

- (1) Hazardous Substances, 49CFR, Parts 171 through 180
- c) American National Standards Institute, Inc. (ANSI):
 - (1) Z9.2-79 Fundamentals Governing the Design and Operation of Local Exhaust
 - (2) Z88.2-80 Practices of Respiratory Protection
- d) Department of Housing and Urban Development (HUD):
 - (1) Guidelines for the Evaluation and Control of Lead Based Paint Hazards in Housing (most current draft or final copy)

5. In addition, the ABATEMENT CONTRACTOR must comply with any applicable regulations promulgated as a result of Title X, the Residential Lead Based Paint Hazard Reduction Act and Title IV, Lead Exposure Reduction Act.

6. Local requirements which govern lead hazard control activities include, but are not limited to, the following:

- a) Air Pollution Control District (APCD) - San Diego County
 - (1) APCD Rules and Regulations, Rule 51 (Public Nuisance), Rule 10-11 (permitting of equipment)
- b) San Diego Municipal Code §54.1001 etc. seq.
 - (1) Prevents, identifies and remedies lead hazards within the City of San Diego

G. PERMITS AND LICENSES

The ABATEMENT CONTRACTOR shall submit to the City in the bid submittal any permits or licenses necessary to carry out this work.

1. Permits

A valid Hazardous Waste Hauler registration is required for transporting any hazardous waste. Certain types of equipment require APCD permits (e.g., abrasive blasters).

2. Licenses

The ABATEMENT CONTRACTOR must be certified by the California Contractors State License Board. The Contractor, or its subcontractor, shall have current licenses, as required by all applicable state or local jurisdictions for the removal, transportation, disposal, or other regulated activity relative to the work described in this plan.

H. HEALTH AND SAFETY

This section describes the equipment and procedures required for protecting workers from Lead contamination and other workplace hazards.

- 1. Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the work.
- 2. Training

a) ABATEMENT CONTRACTOR workers shall be trained in accordance with 8CCR, Section 1532.1 (lead). In addition, workers and supervisors must be lead-trained and have certification for lead-related work from the California Department of Public Health (CDPH).

b) Workers must be provided with initial biological monitoring (blood sampling) if they are occupationally exposed on any day to lead at or above the Action Level (AL). Employees must be provided with biological monitoring and a medical examination if they are occupationally exposed to lead above the action level for more than 30 days in any consecutive 12 month period. Periodic biological monitoring and medical examinations must be performed according to the schedule and criteria specified in T8CCR, Section 1532.1(j). In addition, employees performing "trigger" tasks must be included in biological monitoring and/or medical examinations based on their assumed exposure. In the absence of specific airborne exposure data, medical surveillance will need to be provided for all workers.

c) At a minimum, examinations shall meet all requirements as set forth in T8CCR, Section 1532.1. Furthermore, if an employee's blood levels are at or above 20µg/dl they will not be allowed to work on the project and shall be medically removed until two consecutive blood lead tests show the employee's blood lead level under 15µg/dl.

d) In addition, evaluations of each individual's ability to work in environments capable of producing heat stress in the worker should be completed. Employees who wear respirators must be medically evaluated.

3. Protective clothing

a) Coveralls: Provide disposable "full body" coveralls and disposable head covers, and require that they be worn at all times by all workers in the Work Area. Provide a sufficient number for all required changes, for all workers in the Work Area.

b) Boots: Provide work boots with non-skid soles, and where required by OSHA, foot protection for all workers. Provide boots at no cost to workers. Do not allow boots to be removed from the Work Area for any reason, after being contaminated with lead containing material. Thoroughly clean, decontaminate and bag boots before removing them from Work Area at the end of the work.

c) Hard Hats: Provide head protection (hard hats) as required by OSHA for all workers, and provide 1 spare for use by Owner's Representative, Project Administrator, and Owner. Require hard hats to be worn at all times that work is in progress that may potentially cause head injury. Provide hard hats of the type with plastic strap suspension. Require hats to remain in the Work Area throughout the work. Thoroughly clean, decontaminate and bag hats before removing them from Work Area at the end of the work.

d) Goggles: Provide eye protection (goggles) as required by OSHA for all workers involved in scraping, spraying, or any other activity which may

potentially cause eye injury. Thoroughly clean, decontaminate and bag goggles before removing them from Work Area at the end of the work.

e) Gloves: Provide work gloves to all workers and require that they be worn at all times in the Work Area. Do not remove gloves from Work Area and dispose of as lead contaminated waste at the end of the work.

4. Respirators

a) Air Purifying Respirators

(1) Respirator Bodies: Provide half face or full face type respirators based upon appropriate protection factor as determined by the ABATEMENT CONTRACTORS competent person. .

(2) Filter Cartridges: Provide, at a minimum, HEPA type filters labeled with NIOSH and MSHA Certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists including Lead Containing Dusts and Mists" and color coded in accordance with ANSI Z228.2 (1980). In addition, a chemical cartridge section may be added, if required, for solvents, etc., in use. In this case, provide cartridges that have each section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.

(3) Non permitted respirators: Do not use single use, disposable or quarter face respirators.

(4) Require that respiratory protection be used at all times when there is any possibility of disturbance of lead containing or other hazardous materials whether intentional or accidental.

(5) Require that a respirator be worn by anyone in a Work Area at all times, regardless of activity, during a period that starts with any operation which could cause airborne dust until the area has been cleared for re occupancy.

(6) Regardless of Airborne Levels: Require that the minimum level of respiratory protection used be half-face air purifying respirators with high efficiency filters.

b) Fit testing

(1) Initial Fitting: Provide initial fitting of respiratory protection during a respiratory protection course of training. Only allow an individual to use respirators for which training and fit testing has been provided.

(2) Upon Each Wearing: Require that each time an air purifying respirator is put on it be checked for fit with a positive and negative pressure fit check in accordance with the manufacturer's instructions or ANSI Z88.2 (1980).

- c) Respirators, disposable coveralls, head covers, and foot covers shall be provided by the ABATEMENT CONTRACTOR for the City of San Diego's Asbestos and Lead Management Program's PROJECT MONITOR, and other authorized representatives who may inspect the job site. Provide two (2) respirators and six (6) complete coveralls and, where applicable, six (6) respirator filter changes per day.
- 5. Materials and Equipment
 - a) Only material and equipment that are recognized as being suitable for the intended use, by compliance with appropriate standards, may be used.
- 6. Water Service
 - a) The ABATEMENT CONTRACTOR will be able to obtain water services from on-site facilities. The City will designate the facilities from which water service may be obtained.
- 7. Electrical Services
 - a) The ABATEMENT CONTRACTOR will be able to obtain electrical services from on-site facilities. The City will designate the facilities from which electrical services may be obtained. The ABATEMENT CONTRACTOR shall provide their own electrical hook-ups, i.e. spider boxes, ground fault circuit interrupter (GFCI) etc. and installed by a licensed electrician.
 - b) The electrical services need to comply with the applicable NEMA, NECA, and UL standards, and governing regulations for materials and lay-out of temporary electrical services.
- 8. Sanitary Facilities
 - a) The ABATEMENT CONTRACTOR shall provide sanitary facilities on-site if none have been made available by the City.
- 9. Fire Extinguisher
 - a) Applicable recommendations of the National Fire Protection Association (NFPA) Standard 10, "Standard for Portable Fire Extinguishers," must be complied with by the Contractor. Fire extinguishers need to be located where they are most convenient and effective for their intended purpose, but not less than one (1) extinguisher in each work area, the equipment room, outside/work areas, and in the clean room.
- 10. First Aid
 - a) The ABATEMENT CONTRACTOR will need to provide first aid supplies which should comply with the governing regulations and recognized recommendations within the construction industry.

I. WORK AREA PROCEDURES

1. General guidelines for performing lead hazard control activities are presented in this section and are based on procedures established by HUD for residential settings. Due to the difference between residential settings and commercial buildings, these procedures will be modified on a case-by-case basis.
2. Require that workers NOT eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the Work Area.
3. ABATEMENT CONTRACTOR shall secure work area from access by public, staff or users of the area. Accomplish this where possible, by locking doors, gates, or other means of access to the area.
4. Barricade fencing is required for securing an outside area from unauthorized access. Work area delineation shall occur at no less than twelve feet (12') from the radius of the work and/or building. Yellow caution tape shall not be used.
5. All windows, vents, mechanical systems, etc., in close proximity to the abatement area shall be sealed with plastic and tape by the ABATEMENT CONTRACTOR prior to the work beginning.
6. Warning signs for lead shall be posted as per 8CCR, Section 1532.1(m).
7. A visitor entry and exit-log, and an employee daily sign-in log will be maintained throughout the lead hazard control activities. The ABATEMENT CONTRACTOR shall be responsible for the project site security during the operations in order to protect work efforts and equipment.

J. REMOVAL OF LEAD CONTAINING MATERIALS

1. Lead containing materials shall be adequately wetted with water or a removal encapsulant before and during removal process, to reduce dust emission.
2. The ABATEMENT CONTRACTOR should exercise caution in using water, as he will be solely responsible for any water damage to the facility resulting from the work.
3. ABATEMENT CONTRACTOR is responsible for keeping all hazardous debris within the containment area at all times throughout removal. Any interior contamination, if created, is the responsibility of the ABATEMENT CONTRACTOR to clean with no additional cost to this contract.
4. ABATEMENT CONTRACTOR shall ensure there is no loose debris around the Work Area during the removal and if found, ABATEMENT CONTRACTOR shall clean the area immediately.

K. CLEANING

1. Daily cleaning includes removing large and small debris, HEPA vacuuming horizontal surfaces, wet mopping, and then HEPA vacuuming horizontal surfaces, and possible exterior cleaning.

2. Final cleaning must occur no sooner than one (1) hour after lead hazard control activities are finished. All plastic should be misted, cleaned, and folded toward the center to trap any remaining dust. The order of removal should be upper plastic, the first layer of floor plastic, vent and door plastic, the second layer of floor plastic, and finally plastic separating contaminated from non-contaminated areas. Then the entire area should be cleaned using a HEPA vacuum/wet wash/HEPA vacuum cycle. This should be from ceiling to floor. Paint or otherwise seal treated surfaces with the exception of interior floors (floors will be sealed after clearance). The Supervisor should perform an inspection for visible dust and debris.
3. Additional cleaning cycles may be necessary for porous surfaces, and difficult to clean surfaces (crevices). Failure to meet clearance criteria will require additional cleaning.

L. DECONTAMINATION PROCEDURE

1. Prior to leaving the Work Area, HEPA vacuum outer suit completely and remove, turning it inside out while doing so.
2. Proceed to decontamination area where the second suit is to be removed while turning it inside out.
3. After wiping all areas and respirator, remove respirator and wipe facial area clean.
4. Place contaminated suits, towels, and respirator cartridges in a properly labeled waste containers.
5. At the completion of the project, boots, hard hats, and goggles should be decontaminated and bagged prior to removal from the Work Area.
6. Equipment leaving the Work Area should be HEPA vacuumed and wet wiped.

M. CLEARANCE

1. Clearance must be performed by a California Department of Public Health (CDPH) Certified Lead PROJECT MONITOR. It will not be performed by the ABATEMENT CONTRACTOR (although the ABATEMENT CONTRACTOR may perform their own clearance testing). Clearance testing must occur no sooner than one (1) hour after final cleaning. It consists of two steps; visual examination and possibly environmental sampling (dust and/or soil sampling).
 - a) Visual Examination for Determination of Completed Work:
 - (1) This is a determination that the work specified in the scope of work has been completed satisfactorily. For surfaces that are to be re-painted, it is important this examination occurs prior to the re-painting (to determine that either all the paint has been removed [abatement] or that the deteriorated paint has been stabilized [interim controls]). Next the surfaces should be examined for settled dust and debris. If dust or debris is visually noted, the ABATEMENT

CONTRACTOR will be asked to re-clean prior to samples being collected.

(2) If no such dust/debris is found, the independent consultant or PROJECT MONITOR will complete a Certificate of Visual Inspection (Appendix B) for the area or for multiple areas. The Certified Supervisor will also sign this Certificate. The completed form should be submitted to the City at the end of the project.

2. Environmental Sampling:

a) The number and location of dust and/or soil samples will be determined on a case-by-case basis. The clearance criterion to be used is shown in the table below:

Surface Level

(1)	Interior Floors	40 µg/ft ²
(2)	Interior Window Sills	250 µg/ft ²
(3)	Exterior Horizontal Surfaces	400 µg/ft ²
(4)	Exterior Soil*	1000 µg/ft ²
(5)	Soil in Play Areas*	400 µg/ft ²

b) Re-cleaning, at the Contractor's expense, will be required for surfaces that do not pass clearance criteria.

c) The cost for additional tests, which may be required as a result of samples failing to meet the release criteria, shall be paid for the Contractor. This cost shall include all costs associated with sample analysis and collection of additional samples, including Consultant fees.

* Soil may not be impacted as a part of the proposed work but if contamination occurs then levels shall be used for clearances. ABATEMENT CONTRACTOR may take background soil samples to determine the pre-existing soil conditions.

N. TRANSPORTATION AND DISPOSAL

1. Waste minimization

a) The ABATEMENT CONTRACTOR is required to make all reasonable efforts to minimize the amount of hazardous waste generated from this project.

2. Waste characterization

a) The ABATEMENT CONTRACTOR shall test any potential hazardous waste generated in accordance with 22 CCR Division 4.5 within ten (10) days and/or prior to the end of the project to determine if it is hazardous waste and requires disposal. All paint chips will be considered hazardous waste and do not require testing. Components with lead paint that has been stabilized shall have a hazardous waste determination made prior to sending to a landfill.

3. Pre-transportation requirements
 - a) Any packaging used to ship hazardous waste off site such as a container, roll-off bin, tank or other device, must comply with 49 CFR Parts 173, 178, 179 and be labeled and prepared for transportation in accordance with 22 CCR Article 3.
 - b) The hazardous waste label must be affixed and filled out when the first amount of hazardous waste is placed in the container. The label must include the initial accumulation date.
 - c) All additional pre-transportation labeling, marking or placarding must be conducted prior to transporting off site and in accordance with 22 CCR Chapter 12, Article 3.
4. All containers and tanks of hazardous waste must be managed in a way which minimizes the threat of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste to the air, soil or surface water which could threaten human health or the environment. Management techniques include containment areas capable of holding the contents of largest container within the containment area. Properly store and secure waste at all times. Do not leave hazardous waste in uncovered or unlocked trucks or dumpsters.
5. A hazardous waste manifest will be completed in accordance with 22 CCR Chapter 12, Article 2 for each shipment of hazardous waste leaving the work site. All waste shall leave the project site by the end of the project. Only The PROJECT MONITOR employees shall sign as the generator on manifests.
6. Disposal of the lead related hazardous wastes shall be by incineration unless otherwise specified by the ALMP.

APPENDIX A

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME: _____ DATE: _____

PROJECT ADDRESS: _____

CONTRACTOR'S NAME: _____

Working with lead can be dangerous. Inhaling and ingesting lead dust can cause an increase in blood lead levels which can lead to adverse health effects such as kidney damage, elevated blood pressure or infertility.

Your employer's contract with the City for the above project requires that: You be supplied with the proper respirator and be trained in its use. You be trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These items are to have been done at no cost to you.

RESPIRATORY PROTECTION: You must have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. You must be given a copy of the written respiratory protection manual issued by your employer. You must be equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: You must be licensed by the California Department of Public Health for Lead Hazard Control and be able to provide onsite documentation of training. You should have been trained in the dangers inherent in handling lead and breathing and ingesting lead dust and in proper work procedures and personal and area protective measures. The topics covered in the course must have included the following:

- Possible routes of exposure to lead
- Health hazards associated with lead
- Respiratory protection
- Use of protective equipment
- Work practices including hands on or on-the-job training
- Personal decontamination procedures
- Health and safety considerations

MEDICAL EXAMINATION: You must have had a medical examination within the past 12 months at no cost to you. This examination must have included: health history, physical examination, a blood pressure measurement, pulmonary function test and blood sample and analysis for lead.

By signing this document you are acknowledging only that the City has advised you of your rights to training and protection relative to your employer, the Contractor.

Signature: _____ Social Security No.: _____

Printed Name: _____

Witness (print): _____ Witness Signature: _____

APPENDIX B

CERTIFICATION OF VISUAL INSPECTION

Project # _____ Date: _____ Location: _____

Contractor: _____

The contractor hereby certifies that he/she has visually inspected the Work Area (all surfaces including pipes, counters, ledges, walls, ceiling and floor, behind critical barriers, sheet plastic, etc.) and has found no dust, debris or residue.

by: (Signature): _____ Date: _____

(Print Name): _____

(Company Name): _____

(Print Title): _____

CITY ALMP REPRESENTATIVE

The City ALMP Representative hereby certifies that he has accompanied the contractor on his/her visual inspection and verifies that this inspection has been thorough and to the best of his/her knowledge and belief, the contractor's certification above is a true and honest one.

by: (Signature): _____ Date: _____

(Print Name): _____

WORK AREA

Location: _____

Room: _____

Hazard Reduction Performed:

APPENDIX C

SUMMARY OF LEAD CONTAINING MATERIALS

Sample #	Location	Condition	Lead (mg/cm ²)
	2016 testing		
8	Tan Paint on Pumps	Poor	3.7
12	Exterior Yellow Ballard	Intact	1.8

The remainder of this page is intentionally left blank.

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 **NEWest Construction Company, Inc.**, herein called "Contractor" for construction of **Soledad Pump Station Upgrades**; Bid No. **K-18-1739-DBB-3**; in the amount of **Six Million Eight Hundred Eighty Nine Thousand Seven Hundred Sixty Dollars and Zero Cents (\$6,889,760.00)**, 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:

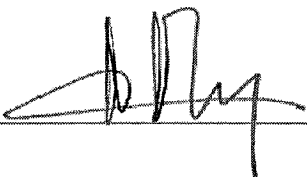
1. The following are incorporated into this contract as though fully set forth herein:
 - (a) The attached Faithful Performance and Payment Bonds.
 - (b) The attached Proposal included in the Bid documents by the Contractor.
 - (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).
 - (d) Phased Funding Schedule Agreement
 - (e) That certain documents entitled **Soledad Pump Station Upgrades**, on file in the office of the Public Works Department as Document No. **B-11072**, 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 **Soledad Pump Station Upgrades**, Bid No. **K-18-1739-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.

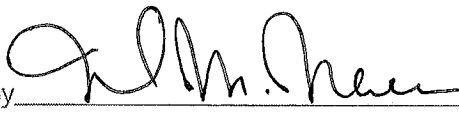
CONTRACT AGREEMENT (continued)

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

APPROVED AS TO FORM

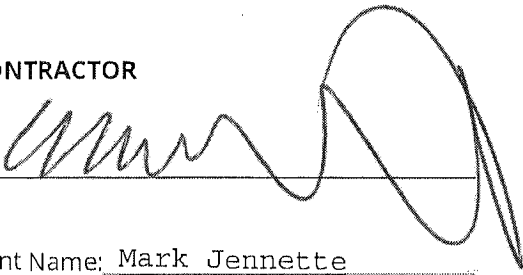
By 
Print Name: Albert Rechany
Deputy Director
Public Works Contracts

Mara W. Elliott, City Attorney
By 
Print Name: Mark C. Mercer
Deputy City Attorney

Date: May 30, 2018

Date: 5/31/18

CONTRACTOR

By 
Print Name: Mark Jennette

Title: President

Date: 4/9/2018

City of San Diego License No.: B2004016715

State Contractor's License No.: 847555

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000002089

CERTIFICATIONS AND FORMS

The Bidder / Proposer, by submitting its electronic bid or proposal, 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 submission 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 has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

CONTRACTOR CERTIFICATION

EQUAL BENEFITS ORDINANCE CERTIFICATION

I declare under penalty of perjury that I am familiar with the requirements of and in compliance with the City of San Diego Municipal Code § 22.4300 regarding Equal Benefits Ordinance.

CONTRACTOR CERTIFICATION

EQUAL PAY ORDINANCE CERTIFICATION

Contractor shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) at section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

Contractor shall require all of its subcontractors to certify compliance with the EPO in their written subcontracts.

Contractor must post a notice informing its employees of their rights under the EPO in the workplace or job site.

By signing this Contract with the City of San Diego, Contractor acknowledges the EPO requirements and pledges ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

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:

Soledad Pump Station Upgrades

(Name of Project or Task)

as particularly described in said contract and identified as Bid No. **K-18-1739-DBB-3**; SAP No. (WBS/IO/CC) **B-11072**; 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 _____, _____.

By: _____

Contractor

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

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	DIR Registration Number	CONSTRUCTOR OR DESIGNER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK	DOLLAR VALUE OF SUBCONTRACT	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB [ⓐ]	WHERE CERTIFIED [ⓑ]	CHECK IF JOINT VENTURE PARTNERSHIP
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____								
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____								

- ⓐ 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 | | |
- ⓑ 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	DIR Registration Number	MATERIALS OR SUPPLIES	DOLLAR VALUE OF MATERIAL OR SUPPLIES	SUPPLIER (Yes/No)	MANUFACTURER (Yes/No)	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB ^①	WHERE CERTIFIED ^②
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**

Bids will not be accepted until ALL the above-named 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 NEWest Construction Co., Inc., 9235 Trade Place, Suite A as Principal, and
San Diego, CA 92126
Arch Insurance Company, 99 High Street, 8th Floor, Boston, as Surety, are
MA 02110
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

Soledad Pump Station Upgrades

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 27th day of March, 2018

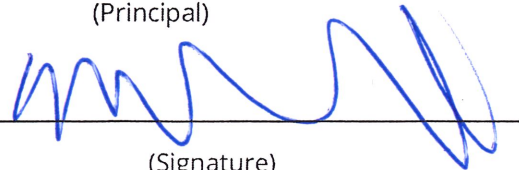
NEWest Construction Co., Inc. (SEAL)

Arch Insurance Company (SEAL)

(Principal)

(Surety)

By:



(Signature)

By:



(Signature)

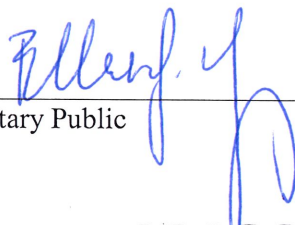
Donna M. Robie, Attorney-in-Fact

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

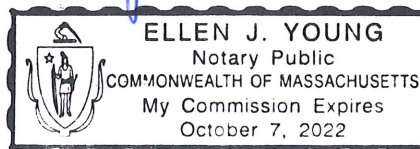
SURETY ACKNOWLEDGMENT

State of: Massachusetts
County of: Middlesex

On this 27th day of March, 2018 before me personally came Donna M. Robie to me known, who, being by me duly sworn, did depose and say that he/she resides at Natick, Massachusetts that he/she is the Attorney-in-fact for Arch Insurance Company the corporation described in and which executed the foregoing instrument; that he/she knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors or said corporation, and that he/she signed his/ her name thereto by like order.



Notary Public



THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON BLUE 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. Not valid for Mortgage, Note, Loan, Letter of Credit, Bank Deposit, Currency Rate, Interest Rate or Residential Value Guarantees.

POWER OF ATTORNEY

Know All Persons By These Presents:

That the Arch Insurance Company, a corporation organized and existing under the laws of the State of Missouri, having its principal administrative office in Jersey City, New Jersey (hereinafter referred to as the "Company") does hereby appoint:

Donna M. Robie, Ellen J. Young and Frank J. Smith of Natick, MA (EACH)

its true and lawful Attorney(s)in-Fact, to make, execute, seal, and deliver from the date of issuance of this power for and on its behalf as surety, and as its act and deed:

Any and all bonds, undertakings, recognizances and other surety obligations, in the penal sum not exceeding Ninety Million Dollars (\$90,000,000.00).

This authority does not permit the same obligation to be split into two or more bonds In order to bring each such bond within the dollar limit of authority as set forth herein.

The execution of such bonds, undertakings, recognizances and other surety obligations in pursuance of these presents shall be as binding upon the said Company as fully and amply to all intents and purposes, as if the same had been duly executed and acknowledged by its regularly elected officers at its principal administrative office in Jersey City, New Jersey.

This Power of Attorney is executed by authority of resolutions adopted by unanimous consent of the Board of Directors of the Company on September 15, 2011, true and accurate copies of which are hereinafter set forth and are hereby certified to by the undersigned Secretary as being in full force and effect:

"VOTED, That the Chairman of the Board, the President, or the Executive Vice President, or any Senior Vice President, of the Surety Business Division, or their appointees designated in writing and filed with the Secretary, or the Secretary shall have the power and authority to appoint agents and attorneys-in-fact, and to authorize them subject to the limitations set forth in their respective powers of attorney, to execute on behalf of the Company, and attach the seal of the Company thereto, bonds, undertakings, recognizances and other surety obligations obligatory in the nature thereof, and any such officers of the Company may appoint agents for acceptance of process."

This Power of Attorney is signed, sealed and certified by facsimile under and by authority of the following resolution adopted by the unanimous consent of the Board of Directors of the Company on September 15, 2011:

VOTED, That the signature of the Chairman of the Board, the President, or the Executive Vice President, or any Senior Vice President, of the Surety Business Division, or their appointees designated in writing and filed with the Secretary, and the signature of the Secretary, the seal of the Company, and certifications by the Secretary, may be affixed by facsimile on any power of attorney or bond executed pursuant to the resolution adopted by the Board of Directors on September 15, 2011, and any such power so executed, sealed and certified with respect to any bond or undertaking to which it is attached, shall continue to be valid and binding upon the Company.

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.

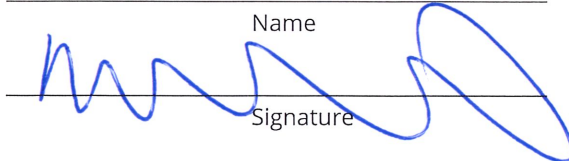
- The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.
- The undersigned certifies that within the 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: NEWest Construction Co., Inc.

Certified By Mark Jennette Title President

Name



Signature

Date 3/27/18

USE ADDITIONAL FORMS AS NECESSARY

Mandatory Disclosure of Business Interests Form

BIDDER/PROPOSER INFORMATION

NEWest Construction Company, Inc.

Legal Name	DBA	
9235 Trade Place Suite "A"	San Diego	CA 92126
Street Address	City	State Zip
Mark Jennette President	858-537-0774 ext 201	858-537-9653
Contact Person, Title	Phone	Fax

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
- the percentage ownership interest in any firm, corporation, or partnership that will receive funds from the transaction,
- the value of any financial interest in the transaction,
- any contingent interest in the transaction and the value of such interest should the contingency be satisfied, and
- any philanthropic, scientific, artistic, or property interest in the transaction.

** Directly or indirectly involved means pursuing the transaction by:

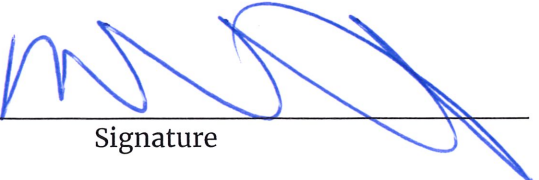
- communicating or negotiating with City officers or employees,
- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, or
- directing or supervising the actions of persons engaged in the above activity.

Mark Jennette	President
Name	Title/Position
San Diego, CA	
City and State of Residence	Employer (if different than Bidder/Proposer)
35% ownership	
Interest in the transaction	
Jack Ryan	CEO
Name	Title/Position
Hingham, MA	
City and State of Residence	Employer (if different than Bidder/Proposer)
20% Ownership	
Interest in the transaction	
Christian Davidson	Controller
Name	Title/Position
Hanover, MA	
City and State of Residence	Employer (if different than Bidder/Proposer)
35% Ownership	
Interest in the transaction	
Kathleen Ryan	Stock Holder
Name	Title/Position
Boston, MA	Boston University
City and State of Residence	Employer (if different than Bidder/Proposer)
10% Ownership	
Interest in the transaction	

Name	Title/Position
City and State of Residence	Employer (if different than Bidder/Proposer)
Interest in the transaction	
Name	Title/Position
City and State of Residence	Employer (if different than Bidder/Proposer)
Interest in the transaction	
Name	Title/Position
City and State of Residence	Employer (if different than Bidder/Proposer)
Interest in the transaction	
Name	Title/Position
City and State of Residence	Employer (if different than Bidder/Proposer)
Interest in the transaction	
Name	Title/Position
City and State of Residence	Employer (if different than Bidder/Proposer)
Interest in the transaction	

*** Use Additional Pages if Necessary ***

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Purchasing Agent with written notice is grounds for Contract termination.

Mark Jennette, President  4/20/18
 Print Name, Title Signature Date

Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.

City of San Diego

CITY CONTACT: Brittany Friedenreich, Contract Specialist, Email: BFriedenreic@sandiego.gov
Phone No. (619) 533-3104

ADDENDUM A



FOR

SOLEDAD PUMP STATION UPGRADES

BID NO.: K-18-1739-DBB-3
SAP NO. (WBS/IO/CC): B-11072
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 1
PROJECT TYPE: BJ, KA

BID DUE DATE:

2:00 PM

March 27, 2018

CITY OF SAN DIEGO

PUBLIC WORKS CONTRACTS

525 B STREET, SUITE 750, MS 908A

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:



13 Mar 2018

Seal:



1) Registered Engineer

Date



3/13/18

Seal:



2) For City Engineer

Date

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.

B. BIDDER'S QUESTIONS

- Q1. Specification 28 23 00 Video Surveillance
There is not a line item in Planetbids to place a bid on this SOW.
Can you please advise how to go about this process?
- A1. The lump sum bid item "Electrical and Instrumentation" is inclusive of video surveillance shown on the schedule of work according to section 701-2, item 19.
- Q2. There is work for Card Reader Access Control per the plans. But there is also nowhere to Bid this SOW on Planet Bids. Please provide.
- A2. The lump sum bid item "Electrical and Instrumentation" is inclusive of the card reader access control according to section 701-2, item 19 and Technical Specification section 11156.
- Q3. Line 6 of the Notice Inviting Bids requires a B License. The Supplementary Special Provisions 2-3.2 Self performance criteria is waived if contractor meets Class B License. Is a B License required typically, this type of project would require an A License given the type of work.
- A3. The Prime Contractor is required to have a Class B License for this contract.
- Q4. If a B License is required for the building. Can we have an SLBE/Other Firm perform the building work under their B License and the remaining portion of the project done under our A License?
- A4. The Prime Contractor is required to have a Class B License for this contract.

- Q5. Since a pre-bid meeting is not being conducted. Can we have access to the existing facilities to exam the areas of demolition and other access issues?
- A5. A non-mandatory pre-bid site visit will be scheduled to allow access to the existing facilities. See revisions per this Addendum A.
- Q6. Just started looking at the drawings for the Soledad Pump Station. There seems to be key dimensions missing on the structural and mechanical drawings. S10 & S12. Drawing S12 refers to the mechanical drawings for the top of the pump pad footing, but M3 does not give an elevation either. The pump can drawing on S21 detail 4 doesn't show the elevation either and calls for a 1' minimum slab where S12 shows 1'-6" minimum. What is the size of the pump pad slab?
- A6. See Section 11002 2.2. The elevation for the top of the pump pad footing on sheet S-12 was not specified because it will be dependent upon the selected pump manufacturer. The contractor will have to work with the pump manufacturer who will give requirements for the depth, size, and space within the pump well. We also have 2 different sized pumps so the pump wells will be slightly different sizes.

The thickness of the pump pad slab is 1'-6" minimum as shown on sheet S-12, Building Section A.

- Q7. In the electrical room are the walls masonry (S-10, S-15) or concrete and masonry as shown on (S-14)? What is the elevation and length if some is concrete? Is there any way to get better dimensions and elevations on the structural drawings? It seems a lot of this structure will be back filled according to drawings A-11 and A-12, is this correct? Can some elevations be given? According to note 3 on A-12 as well as other places the concrete is to be colored which is expensive. There are no elevations given for this. Need better direction on what depth we are going around the building. Or is all the exterior concrete to be colored?
- A7. All the walls on the electrical room are per A-3 and A-8, Notes 1-4. All dimensions and elevations are indicated at A-6 through A-10, and all architectural plans and details are drawn to scale unless noted otherwise.

Yes, backfilling operation will be required. The contour lines elevation information are provided at C-1, C-4, C-6, and the architectural section elevations are indicated at A-6, A-7 and A-10.

All cast-in-place and exposed concrete colors, elevations and dimensions are indicated at A-3 through A-7, A-11 and A-12.

Q8. Section 13205 Modifications to Existing Concrete Water Tank

Part 2.1 lists the acceptable manufactures of the Tank Level Gauge as CB&I located in San Luis Obispo CA. The CB&I office in San Luis Obispo is closed. CB&I (Chicago Bridge and Iron Company) does not manufacture tank gauges. CB&I is a tank builder.

I spoke with Grahm with CB&I out of the Everett Washington Office and they typically buy the equipment and gauges from Shand & Jurs.

Section 4-1.6 requires a proposed substitution 15 days before bid time. Since the approved manufacture does not really manufacture the Tank Gauges. We are submitting the Shand & Jurs Liquid Level Indicator.

A8. Shand & Jurs is an acceptable manufacturer.

Q9. 1. We need you to either give us the specification section where the instrumentation devices are or specify them.

2. On drawing S-16, note 2, what is the size and depth of the existing pump barrels and slab?

3. On drawing S-16, are we just putting in two pilasters or are we putting in 10 pilasters, 2 at each pipe penetration?

4. Just want to confirm the ribbon gutter is 7" thick.

5. On drawing C-4 Item "B" under construction items calls out the wall to be 24'+/-, it appears that this should be 34'+/-. Please clarify.

6. On bid item 37 is the quantity correct for CMU retaining wall? On C-4 it shows four retaining walls but "D" is shown to be cast in place. Are there any other CMU retaining walls not accounted for?

7. I noticed a discrepancy which we would like clarified (see snippet below):

ANSI/ASME (Class 150 flange specified below) can only be used for vessels rated up to ~ 275 psig at 105°F. However, Vessel (surge tank) is specified to be rated for 300 psig. We can do one or the other of the two (2) options listed below:

Rate vessel for ~ 275 psig. Or

Use ASME? ANSI Class 300 flanges. Note: ASME Pressure Vessels use ASME / ANSI B16.5 flanges which can mate to AWWA Class E.

Please advise. Thanks.

DESIGN AND PERFORMANCE REQUIREMENTS	
A.	System Supplier to develop recommended set points in agreement with the Surge Analysis Report.
B.	System shall be tailored to the following conditions.
Service:	Outdoors environmental temperature range of 35°F to 105°F
Elevation:	725 feet above mean sea level
Tank volume:	4,500 gallons
Normal volume of air in tank:	50% tank size (2,250 gallons)
Max volume of air in tank at max pressure (113 psi)	75% tank size (3,375 gallons)
Tank Operating Pressure Range:	50 – 200 psig
Design pressure:	300 psig
Tank Test Pressure	1.3 x design pressure
Pressure rating of flanged outlets:	Class 150 per ASME B16.5 or Class E per AWWA C207
Tank inlet/outlet pipe size:	8-inch
Liquid level sight gauge pressure rating:	300 psi (water service)
Safety relief valve pressure rating:	300 psi WOG
Solenoid valve pressure rating and maximum differential pressure:	250 psi

goes up to only ~ 275 psig.

A9. A9.1 Instrumentation devices are in the specifications and plans.

A9.2 Follow as-built drawing 14853-2-D in Appendix K.

A9.3 Two (2) pilasters total.

A9.4 Follow City of San Diego standard drawings SDG-157.

A9.5 See C-4, Construction item B, the CMU wall has a total linear feet for less than 8' high wall = 24 +/-, and the total linear feet between 8' to 10' high wall = 11+/-.

A9.6 Cast in place concrete retaining wall is part of line item 37. No other CMU walls unaccounted for.

A9.7 Design pressure shall be 275 psig not 300 psig. See revisions per this Addendum A.

Q10. When investigating the pump can dimensions, we discovered a few items that should be corrected in the specification.

A10. See revisions per this Addendum A.

Q11. Please explain details 6, 7 and 8 on S-7. Where are these shown on the drawings? How many of each are there? What is the size?

A11. Details 6 and 7 on sheet S-7 are for repairing concrete around one 16" outlet pipe exiting the reservoir's slab. They're called out at the top of the elevation drawing located on the middle left side of sheet C-12, Details 1, 2 & 3. Detail 8 is for the temperature sensor shown in the middle of the reservoir roof on sheet C-4 and is also detailed at the bottom left of sheet S-22, detail 5.

Q12. How thick are the pads shown on detail 1, C-17? What is the rebar requirements or mesh?

A12. The air valve pads are 6" thick concrete slab according to SDW-159. Reinforcing bars are not required.

Q13. This project is asking for a Class "D" field office to be used by the City and separate from the contractor's office/trailer. The site does not look like there is room for two trailers. Can you confirm where the laydown area and trailer locations are?

A13. The Class "D" Field/Construction Management Field Office may be situated at the future graded area for the SDG&E transformer and meter. The contractor has to find their own staging area and office space either onsite or offsite.

Q14. On drawing A-11 note 28, how do you want these score lines created?
Sawcut?

A14. Yes, the scores maybe sawcut, but cannot be sawcut deeper than 1".

C. NOTICE INVITING BIDS

1. **ADD** the following:

PRE-BID SITE VISIT: All those wishing to submit a bid are **encouraged** to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Public Works Contracts at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: 10:00 AM-12:00 PM

Date: March 21, 2018

Location: 6751 1/3 La Jolla Scenic South, San Diego, CA 92037

D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Attachment E, Technicals 11214, page 391, VERTICAL TURBINE PUMPS, Part 2 – PRODUCTS, Section 2.7 EQUIPMENT, sub-section F Discharge Head and Drive Unit Support, second paragraph, **DELETE** in its entirety and **SUBSTITUTE** with the following:

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 fabricated of steel for pumps P-3 and P-4, shall be fabricated steel for pumps P-1 and P-2 and shall be designed to accommodate the equipment specified.

2. To Attachment E, Technicals, 11214, page 391, VERTICAL TURBINE PUMPS, Part 2 – PRODUCTS, Section 2.7 EQUIPMENT, sub-section G

Pump Cans, Item a, **DELETE** in its entirety and **SUBSTITUTE** with the following:

a. Size the barrel or can as shown on the drawings and CONTRACTOR shall verify maximum fluid velocity of 3 fps for pumps P-1 and P-2 and 4 fps for Pumps P-3 and P-4, in the annular space between the pump column and flange or coupling and the inside of the barrel or can at the maximum flow.

3. To Attachment E, Technicals 11214, page 392, VERTICAL TURBINE PUMPS, Part 2 – PRODUCTS, Section 2.7 EQUIPMENT, sub-section G Pump Cans, Item c, **DELETE** in its entirety and **SUBSTITUTE** with the following:

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.

4. To Attachment E, Technicals 15175, page 525, HYDROPNEUMATIC SURGE CONTROL SYSTEM, Part 1 – General, Section 1.7 DESIGN AND PERFORMANCE REQUIREMENTS, Item B, **DELETE** in its entirety and **SUBSTITUTE** with the following:

B. System shall be tailored to the following conditions.

Service:	Outdoors environmental temperature range of 35°F to 105°F
Elevation:	725 feet above mean sea level
Tank volume:	4,500 gallons
Normal volume of air in tank:	50% tank size (2,250 gallons)
Max volume of air in tank at max pressure (113 psi)	75% tank size (3,375 gallons)
Tank Operating Pressure Range:	50 – 200 psig
Design pressure:	275 psig
Tank Test Pressure	1.3 x design pressure
Pressure rating of flanged outlets:	Class 150 per ASME B16.5 or Class E per AWWA C207
Tank inlet/outlet pipe size:	8-inch
Liquid level sight gauge pressure rating:	300 psi (water service)

Safety relief valve pressure rating:	300 psi WOG
Solenoid valve pressure rating and maximum differential pressure:	250 psi

James Nagelvoort, Director
Public Works Department

Dated: *March 15, 2018*
San Diego, California

JN/RWB/ss

Bid Results

Bidder Details

Vendor Name NEWest Construction Co., Inc.
Address 9235 Trade Place
 Suite A
 San Diego, CA 92126
 United States
Respondee Mark Jennette
Respondee Title President
Phone 858-537-0774 Ext. 201
Email mjennette@newestco.com
Vendor Type CADIR,PQUAL,Local
License # 847555
CADIR 1000002089

Bid Detail

Bid Format Electronic
Submitted March 27, 2018 1:45:10 PM (Pacific)
Delivery Method
Bid Responsive
Bid Status Submitted
Confirmation # 135963
Ranking 0

Respondee Comment

Buyer Comment

Attachments

File Title	File Name	File Type
Cert Page	Certification Pending Actions.pdf	Contractor's Certification of Pending Actions
Bid Bond	Bid Bond.pdf	Bid Bond

Line Items

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
Main Bid						
1	Bonds (Payment and Performance)					
	524126	LS	1	\$50,400.00	\$50,400.00	
2	Inspection Paid For By the Contractor					
	237110	LS	1	\$6,000.00	\$6,000.00	
3	Testing Under the Direction of the Engineer (EOC Type I)					
	237110	AL	1	\$74,000.00	\$74,000.00	
4	WPCP Development					
	541330	LS	1	\$9,000.00	\$9,000.00	
5	WPCP Implementation					
	237110	LS	1	\$18,800.00	\$18,800.00	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
6	Dewatering Permit and Discharge Fees (EOC Type I)					
	237110	AL	1	\$500.00	\$500.00	
7	Dewatering Non-Hazardous Contaminated Water					
	237110	LS	1	\$3,000.00	\$3,000.00	
8	Video Recording of Existing Conditions					
	238990	LS	1	\$4,200.00	\$4,200.00	
9	Exclusive Community Liaison Services					
	541820	LS	1	\$30,000.00	\$30,000.00	
10	Preparation of Waste Management Form					
	238910	LS	1	\$600.00	\$600.00	
11	Site Storage and Handling of Construction and Demolition Waste					
	238910	TON	100	\$18.75	\$1,875.00	
12	Disposal of Construction and Demolition Waste					
	238910	TON	100	\$135.00	\$13,500.00	
13	Field Office Class D					
	238990	LS	1	\$5,000.00	\$5,000.00	
14	Modify Existing Northwest Altitude Valve Vault					
	238910	LS	1	\$6,770.00	\$6,770.00	
15	Surge Tank and Compressor					
	238910	LS	1	\$176,600.00	\$176,600.00	
16	Miscellaneous Reservoir Upgrades					
	238910	LS	1	\$1,064,000.00	\$1,064,000.00	
17	Meter and Valve Building					
	238910	LS	1	\$33,800.00	\$33,800.00	
18	Pump Station Building					
	237110	LS	1	\$1,270,000.00	\$1,270,000.00	
19	Pump Station Piping and Appurtenances					
	237110	LS	1	\$376,000.00	\$376,000.00	
20	Vertical Turbine Pumps, 75 HP, Constant Speed					
	237110	EA	2	\$88,000.00	\$176,000.00	
21	Vertical Turbine Pumps, 50 HP, Constant Speed					
	237110	EA	2	\$58,000.00	\$116,000.00	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
22	Cathodic Protection System					
	237110	LS	1	\$34,760.00	\$34,760.00	
23	Mobilization					
	237110	LS	1	\$253,000.00	\$253,000.00	
24	Field Orders (EOC Type II)					
		AL	1	\$425,000.00	\$425,000.00	
25	Clearing and Grubbing					
	238910	LS	1	\$49,000.00	\$49,000.00	
26	Tree Removal					
	238910	EA	22	\$815.00	\$17,930.00	
27	Excavate and Export (Unclassified)					
	237310	CY	100	\$30.00	\$3,000.00	
28	Class 2 Aggregate Base					
	237310	TON	75	\$102.00	\$7,650.00	
29	Crushed Aggregate Base					
	238910	TON	100	\$96.00	\$9,600.00	
30	Asphalt Pavement Repair					
	237310	TON	110	\$156.00	\$17,160.00	
31	Asphalt Concrete Dike (Type A)					
	237310	LF	470	\$13.50	\$6,345.00	
32	Concrete Pavement (12 Inch thick)					
	238910	CY	12	\$2,020.00	\$24,240.00	
33	Storm Drain Clean Out (Type A)					
	237110	EA	3	\$12,700.00	\$38,100.00	
34	Catch Basin (Type F)					
	237110	EA	1	\$6,830.00	\$6,830.00	
35	Drainage Ditch (Type B)					
	237110	LF	175	\$96.00	\$16,800.00	
36	Concrete Pipe Collar					
	237110	EA	1	\$1,200.00	\$1,200.00	
37	Concrete Block Masonry Retaining Wall (See plans)					
	238110	SF	1100	\$153.00	\$168,300.00	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
38	Additional Curb and Gutter Removal and Replacement					
	237310	LF	20	\$90.00	\$1,800.00	
39	Additional Sidewalk Removal and Replacement					
	237310	SF	100	\$9.60	\$960.00	
40	Commercial Concrete Driveway					
	237310	SF	200	\$46.00	\$9,200.00	
41	Concrete Ribbon Gutter					
	237310	LF	280	\$58.00	\$16,240.00	
42	Steel Fencing					
	238990	LF	700	\$246.00	\$172,200.00	
43	Double Access Gates					
	238990	EA	1	\$18,760.00	\$18,760.00	
44	Removal or Abandonment of Existing Water Facilities					
	237110	LS	1	\$20,000.00	\$20,000.00	
45	Large Water Main Abandonment					
	237110	LS	1	\$20,000.00	\$20,000.00	
46	Electrical Demolition and Abandonment					
	237110	LS	1	\$10,000.00	\$10,000.00	
47	Western Altitude Valve Vault Demolition and Abandonment					
	237110	LS	1	\$2,500.00	\$2,500.00	
48	Irrigation Demolition and Abandonment					
	237110	LS	1	\$9,000.00	\$9,000.00	
49	Eastern Altitude Valve Vault Demolition and Abandonment					
	237110	LS	1	\$5,000.00	\$5,000.00	
50	Handling and Disposal of Non-friable Asbestos Material					
	237110	LS	1	\$6,000.00	\$6,000.00	
51	Concrete Block Wall Demolition					
	238910	LS	1	\$3,300.00	\$3,300.00	
52	Concrete Ditch Demolition					
	238910	LS	1	\$3,400.00	\$3,400.00	
53	Fencing Demolition					
	238910	LS	1	\$15,000.00	\$15,000.00	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
54	Storm Drain Demolition					
	238910	LS	1	\$3,000.00	\$3,000.00	
55	Pump Station Building Demolition					
	238910	LS	1	\$42,000.00	\$42,000.00	
56	Storm Drain with Lug Connections (12 Inch)					
	237110	LF	110	\$230.00	\$25,300.00	
57	Storm Drain with Lug Connections (8 Inch)					
	237110	LF	60	\$273.00	\$16,380.00	
58	Water Main (16 Inch)					
	237110	LF	600	\$720.00	\$432,000.00	
59	Sewer Force Main (2 Inch)					
	237110	LF	250	\$58.00	\$14,500.00	
60	Trench Shoring					
	237110	LS	1	\$300,000.00	\$300,000.00	
61	Butterfly Valve (16 Inch, Class 150B)					
	237110	EA	14	\$3,050.00	\$42,700.00	
62	Gate Valve (3 Inch)					
	237110	EA	1	\$650.00	\$650.00	
63	Gate Valve (4 Inch)					
	237110	EA	1	\$650.00	\$650.00	
64	Gate Valve (6 Inch)					
	237110	EA	7	\$978.00	\$6,846.00	
65	Gate Valve (8 Inch)					
	237110	EA	4	\$1,325.00	\$5,300.00	
66	Gate Valve (10 Inch)					
	237110	EA	3	\$2,200.00	\$6,600.00	
67	Gate Valve (12 Inch)					
	237110	EA	4	\$3,200.00	\$12,800.00	
68	Water Valve Bypass for T-Mainline 16 Inch and Larger					
	237110	EA	6	\$2,400.00	\$14,400.00	
69	Meter Assembly					
	237110	EA	1	\$71,115.00	\$71,115.00	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
70	6 Inch Emergency Bypass Connections					
	237110	LS	1	\$8,920.00	\$8,920.00	
71	Combination Vacuum Relief-Air Inlet and Air Release Valves, (2 Inch, Class 150)					
	237110	EA	2	\$23,300.00	\$46,600.00	
72	Double Ball Expansion Joints					
	237110	EA	4	\$20,040.00	\$80,160.00	
73	Temporary Resurfacing					
	237310	TON	21	\$194.00	\$4,074.00	
74	Thrust Blocks and Anchor Blocks for 16 Inch and Larger Water Mains					
	237110	EA	2	\$2,435.00	\$4,870.00	
75	Connection to Existing Manhole and Rechanneling					
	237110	EA	1	\$900.00	\$900.00	
76	Striping					
	237310	LS	1	\$4,200.00	\$4,200.00	
77	Removal of Traffic Striping and Curb Markings					
	237310	LS	1	\$1,345.00	\$1,345.00	
78	Traffic Control					
	237310	LS	1	\$17,640.00	\$17,640.00	
79	SDG&E Service Orders					
	238210	LS	1	\$12,000.00	\$12,000.00	
80	Electrical and Instrumentation					
	238210	LS	1	\$650,000.00	\$650,000.00	
81	Landscaping and Irrigation					
	561730	LS	1	\$163,600.00	\$163,600.00	
82	Connections to The Existing System by Contractor (8 Inch through 12 Inch)					
	237110	EA	1	\$23,800.00	\$23,800.00	
83	Connections to The Existing System by Contractor (16 Inch)					
	237110	EA	1	\$24,190.00	\$24,190.00	
84	Cut and Plug by Contractor					
	237110	EA	8	\$2,425.00	\$19,400.00	
85	Pavement Restoration for Final Connection					
	237110	SF	500	\$11.00	\$5,500.00	
				Subtotal	\$6,889,760.00	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
				Total	\$6,889,760.00	

Subcontractors

Name & Address	Description	License Num	CADIR	Amount	Type
Concrete Building Systems 3485 Live Oak Creek Circle, Fallbrook, CA, 92028 Fallbrook, CA 92028 United States	Concrete - SLBE	484842	1000000942	\$561,700.00	CAU,FEM,CADIR,WB E
DN Tanks, Inc. 351 Cypress Lane El Cajon, CA 92020 United States	Tank Modifications	979914	1000005732	\$784,000.00	
Jennette Company, Inc. 11512 Trailbrook Lane San Diego, CA 92128 United States	Building Work/Site Demo/Paving/Landscape/Fen ce ELBE	1007413	1000042413	\$995,000.00	