

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

FAX NO.: 858-537-9653

CITY CONTACT: Angelica Gil - Contract Specialist,

Email: AngelicaG@sandiego.gov

Phone No. (619) 533-3622, Fax No. (619) 533-3633

D.Manela / J. Borja / Lad

BIDDING DOCUMENTS



ORIGINAL



FOR

LA JOLLA COUNTRY CLUB RESERVOIR AND PUMP STATION

BID NO.: _____ K-17-1191-DBB-3

SAP NO. (WBS/IO/CC): _____ B-11024

CLIENT DEPARTMENT: _____ 2000

COUNCIL DISTRICT: _____ 1, 6

PROJECT TYPE: _____ BJ / BK

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:

2:00PM

APRIL 11, 2017

CITY OF SAN DIEGO

PUBLIC WORKS CONTRACTS

1010 SECOND AVENUE, 14th FLOOR, MS 614C

SAN DIEGO, CA 92101

ENGINEER OF WORK

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

Gail K. Maskew
1) Registered Engineer

3/7/17
Date

Seal:



[Signature]
2) For City Engineer

3/7/17
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 **La Jolla Country Club Reservoir and Pump Station**. For additional information refer to Attachment A.
2. **FULL AND OPEN COMPETITION:** This contract is open to full competition and may be bid on by Contractors who are on the City's current Prequalified Contractors' List. For information regarding the Contractors Prequalified list visit the City's web site: <http://www.sandiego.gov>.
3. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **\$5,220,000**.
4. **BID DUE DATE AND TIME ARE: APRIL 11, 2017, at 2:00PM**
5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.
6. **LICENSE REQUIREMENT:** The City has determined that the following licensing classification(s) are required for this contract: **A.**
7. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** 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	12.5%
2.	ELBE participation	27.0%
3.	Total mandatory participation	39.5%
 - 7.2. The Bid may be declared non-responsive if the Bidder fails the 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. PRE-BID MEETING:

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

Date: March 16, 2017

Time: AT 10:00 A.M.

Location: 1010 Second Avenue, 14th Floor, San Diego, CA 92101 (Large Conference Room)

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

9. AWARD PROCESS:

- 9.1.** The Award of this contract is contingent upon the Contractor's compliance with all conditions of Award as stated within these documents and within the Notice of Intent to Award.
- 9.2.** Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening. The City will then award the Contract within approximately 14 days of receipt of properly signed Contract, bonds, and insurance documents.
- 9.3.** This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.
- 9.4.** The low Bid will be determined by Base Bid alone.
- 9.5.** Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base bid alone; or for the Base bid plus one or more alternates.

10. SUBMISSION OF QUESTIONS:

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

Public Works Contracts
1010 Second Avenue, 14th Floor
San Diego, California, 92101

Attention: Juan E. Espindola - Contract Specialist

OR:

JEEspindola@sandiego.gov

- 10.2. Questions received less than 14 days prior to the date for opening of Bids may not be considered.
 - 10.3. Questions or clarifications deemed by the City to be material shall be answered via issuance of an addendum and posted to the City's online bidding service.
 - 10.4. Only questions answered by formal written addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect. It is the Bidder's responsibility to be informed of any addenda that have been issued and to include all such information in its Bid.
11. **PHASED FUNDING:** For Phased Funding Conditions, see Attachment B.

INSTRUCTIONS TO BIDDERS

1. PREQUALIFICATION OF CONTRACTORS:

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

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

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

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

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

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

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

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

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

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

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

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

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

2.8. ACCESSIBILITY AND AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE: To request a copy of this solicitation in an alternative format, contact the Public Works Contract Specialist listed 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 further state within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3, "Subcontracts", which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which Bidders are seeking recognition towards achieving any mandatory, voluntary (or both) subcontracting participation goals.

- 14.2. LISTING OF SUPPLIERS.** Any Bidder seeking the recognition of Suppliers of equipment, materials, or supplies obtained from third party Suppliers towards achieving any mandatory or voluntary (or both) subcontracting participation goals shall provide, at a minimum, the **NAME, LOCATION (CITY)** and the **DOLLAR VALUE** of each supplier. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for materials and supplies unless vendor manufactures or substantially alters materials and supplies, in which case, 100% will be credited. The Bidder is to indicate within the description whether the listed firm is a supplier or manufacturer. If no indication is provided, the listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage.
- 14.3. LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES.** For subcontractors or suppliers to be used on additive or deductive alternate Items, in addition to the above requirements, bidder shall further note "ALTERNATE" and alternate item number within the description.
- 15. SUBMITTAL OF "OR EQUAL" ITEMS:** See Section 4-1.6, "Trade Names or Equals" in The WHITEBOOK and as amended in the SSP.
- 16. AWARD:**
- 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 Co., 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 Two Hundred Eighty-Six Thousand Four Hundred Sixty Dollars and Zero Cents
(\$6,286,460.00) for the faithful performance of the annexed contract, and in the sum of **Six Million**
Two Hundred Eighty-Six Thousand Four Hundred Sixty Dollars and Zero Cents (\$6,286,460.00)
for the benefit of laborers and materialmen designated below.

La Jolla Country Club Reservoir and Pump

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.

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

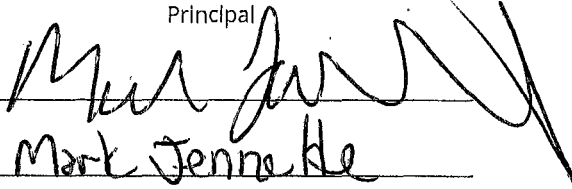
PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

Dated _____

Approved as to Form

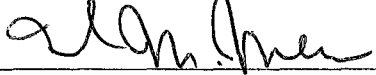
NEWest Construction Co., Inc.

Principal

By 
Mark Jenneke

Printed Name of Person Signing for Principal

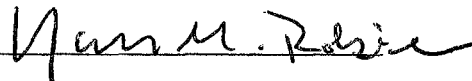
Mara W. Elliott, City Attorney

By 

Deputy City Attorney

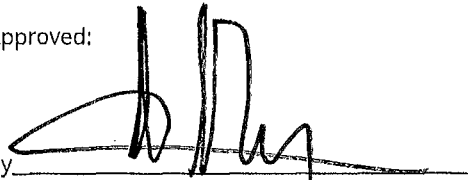
Arch Insurance Company

Surety

By 

Attorney-in-fact Donna M. Robie

Approved:



Albert P. Recharny
Deputy Director
Public Works Department

Jere Keprios
c/o C T Corporation
818 West Seventh Street, 2nd Floor
Local Address of Surety
Los Angeles, CA 90017

Local Address (City, State) of Surety

213-627-8252

Local Telephone No. of Surety

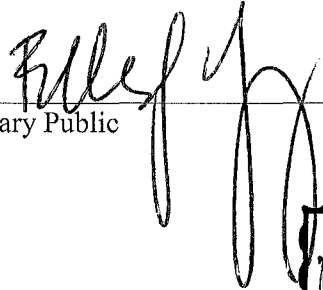
Premium \$ 48,280.00

Bond No. SU1140473

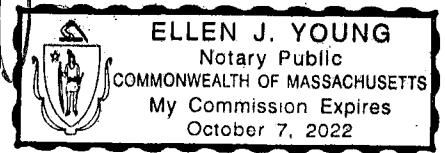
SURETY ACKNOWLEDGMENT

State of: Massachusetts
County of: Middlesex

On this ____ day of _____, 2017 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. Roble, 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."

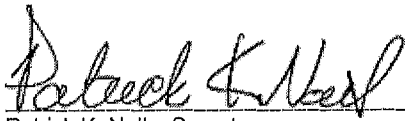
This Power of Attorney is signed, sealed and certified by facsimile under and by authority of the following resolution adopted by the unanimous consent of the Board of Directors of the Company on September 15, 2011:

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.

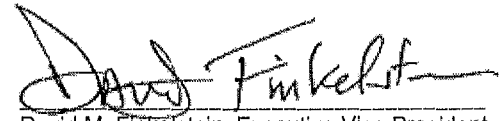
In Testimony Whereof, the Company has caused this instrument to be signed and its corporate seal to be affixed by their authorized officers, this 21st day of June, 2016.

Attested and Certified

Arch Insurance Company


Patrick K. Nails, Secretary

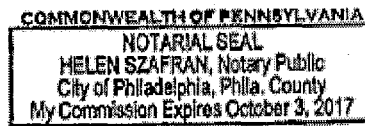


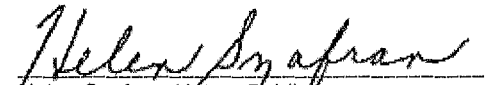

David M. Finkelstein, Executive Vice President

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.

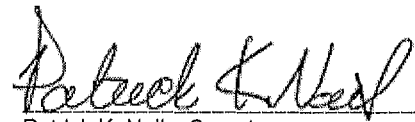



Helen Szafran, Notary Public
My commission expires 10/03/2017

CERTIFICATION

I, Patrick K. Nails, Secretary of the Arch Insurance Company, do hereby certify that the attached Power of Attorney dated June 21, 2016 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 _____ day of _____, 20_____.


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:** Demolition, salvage, recycling, disposal of the existing pump station and reservoir, and construction of new reservoir and pump station facilities, emergency portable generator, security and surveillance systems, site improvements including fencing, grading and landscaping, and all other required work specified in the Contract Documents for a complete and functional system. Contractor shall coordinate with City to relocate bypass piping, SCADA equipment and otherwise provide for the uninterrupted water service to the 725 and 925 pressure zones via other water supply facilities.

1.1. The Work shall be performed in accordance with:

1.1.1. The Notice Inviting Bids and Plans numbered **39252 -1-D** through **39252 - 75-D**, inclusive.

2. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **\$5,220,000**.

3. **LOCATION OF WORK:** **7269 Encelia Drive, La Jolla CA 92073.**

4. **CONTRACT TIME:** The Contract Time for completion of the Work, including the Plant Establishment Period, shall be **360 Working Days**.

4.1. **CONTRACTOR'S LICENSE CLASSIFICATION:** In accordance with the provisions of California Law, the Contractor shall possess valid, appropriate licenses at the time that the Bid is submitted. Failure to possess the specified licenses may render the Bid as **non-responsive** and ineligible for award.

4.2. The City has determined that the following licensing classifications are required for this contract:

Option	Classification
1	CLASS A

4.3. The Bidder shall satisfy the licensing requirement by meeting **at least** one of the listed options.

ATTACHMENT B
PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PHASED FUNDING:

- 1.1.** For phased funded contracts, the City typically secures enough funds for the first 90 days of the contract prior to award. Within 10 Working Days after Bid opening date the Apparent Low Bidder must contact the Project Manager to discuss fund availability and the duration of the first phase and submit the Pre-Award Schedule to the City for approval and preparation of the first Phased Funding Schedule Agreement.
- 1.2.** The Apparent Low Bidder will be required to provide a Pre-award Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 9-3, "PAYMENT" prior to award of Contract.
- 1.3.** If the Bid submitted by the Apparent Low Bidder is rejected by the City for any reason, the next Apparent Low Bidder is to provide the Pre-Award Schedule within 5 Working Days after receiving notice. This process will continue until the City selects an Awardee or rejects all Bids.
- 1.4.** The first Phased Funding Schedule Agreement must show the fund availability for the first phase. Upon selection of the Awardee and acceptance by the City of the Pre-Award Schedule, the City will present the first Phased Funding Schedule Agreement to you.
- 1.5.** At the City's request, meet with the City's project manager before execution of the first Phased Funding Schedule Agreement to discuss their comments and requests for revision to the Pre-Award Schedule.
- 1.6.** Your failure to perform the any of the following may result in the Bid being rejected as non-responsive:
 1. Meet with the City's project manager, if requested to do so, to discuss and respond to the City's comments regarding the Pre-Award Schedule,
 2. Revise the Pre-Award Schedule as requested by the City within the specified 22 Working Days timeframe, or
 3. Execute the first Phased Funding Schedule Agreement within a day after receipt.

PHASED FUNDING SCHEDULE AGREEMENT

Check one:

- First Phased Funding Schedule Agreement
- Final Phased Funding Schedule Agreement

BID NUMBER: K-17-1191-DBB-3 Phase Funding

CONTRACT TITLE: La Jolla Country club reservoir and pump station

CONTRACTOR: Newest Construction Co., Inc.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	Mobilization, bonds, demolition, bypass, piping, temporary power systems	NTP	8/31/18	\$4,000,000
2	New reservoir and pump station construction, electrical/mechanical, civil/site, closeout	9/1/18	NOC	\$2,286,460
Total				\$6,286,460

Notes:

- (1) City Supplement 9-3.6, "PHASED FUNDING COMPENSATION" applies.
- (2) The total of all funding phases shall be equal to the TOTAL BID PRICE as shown on BID SCHEDULE 1 - PRICES.
- (3) This PHASED FUNDING SCHEDULE AGREEMENT will be incorporated into the CONTRACT and shall only be revised by a written modification to the CONTRACT.

CITY OF SAN DIEGO

CONTRACTOR

By: B. David Mark

By: Mark Jennelle

Name: B. David Mark

Name: Mark Jennelle

Project Manager

Department Name: public works

Title: President

Date: 10/1/17

Date: 10/1/17

END OF PHASED FUNDING SCHEDULE AGREEMENT

ATTACHMENT C
INTENTIONALLY LEFT BLANK

ATTACHMENT D
PREVAILING WAGES

ATTACHMENT D

PREVAILING WAGES

1. **PREVAILING WAGE RATES:** Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding \$25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding \$15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.
 - 1.1. **Compliance with Prevailing Wage Requirements.** Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.
 - 1.1.1. Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at <http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.
 - 1.1.2. The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.
 - 1.2. **Penalties for Violations.** Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate for the work or craft in which the worker is employed.

- 1.3. Payroll Records.** Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.
- 1.3.1.** For contracts entered into on or after April 1, 2015, Contractor and their subcontractors shall furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.
- 1.4. Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor is held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.
- 1.5. Working Hours.** Contractor and their subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay; and (ii) specify penalties to be imposed on design professionals and subcontractors of \$25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code 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. As of March 1, 2015, no contractor or subcontractor may be listed on a bid or proposal for a public works project unless registered with the DIR pursuant to Labor Code section 1725.5. As of April 1, 2015, a contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal, or enter into any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5. By submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration to the City upon request.

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

ATTACHMENT E
SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

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

1. 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:
 1. 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 8:30 AM to 3:30 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. You shall perform, with your own organization, Contract Work amounting to at least 50% of the base Bid **AND** 50% of any alternates.

- 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) Geotechnical Investigation, La Jolla Country Club Reservoir and Pump Station Project, La Jolla, California, prepared by Southern California Soil and Testing, Inc., February 28, 2012.

- b) Updated Seismic Design Criteria, La Jolla Country Club Reservoir and Pump Station Project, La Jolla, California, prepared by Southern California Soil and Testing, Inc., July 21, 2014.
 - c) Infiltration Rate Potential, La Jolla Country Club Reservoir and Pump Station Project, La Jolla, California, prepared by Southern California Soil and Testing, Inc., November 3, 2015.
5. The reports listed above are available for review by contacting the Contract Specialist or visiting:

<ftp://ftp.sannet.gov/OUT/ECP/2-7%20SUBSURFACE%20DATA/>

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:
 - 1. Biological Assessment for the La Jolla Country Club Reservoir Replacement Project dates December 4, 2013.
- 4. The reports listed above are available for review by contacting the Contract Specialist or visiting:

<ftp://ftp.sannet.gov/OUT/ECP/215%20TECHNICAL%20STUDIES%20AD%20DTA/>

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.

3-5.1.7 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.

3-5.1.8 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.

3-5.1.8.1 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

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

- 1. The special inspections required are listed as follows:
 - a) Refer to Plans Sheets: S-1, S-2, S-3, S-4.

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 later than 5 Working Days after the determination of the Apparent Low Bidder** and on the City's Product Submittal Form available at:

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

SECTION 5 – UTILITIES

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

- g) Refer to Appendix “J” for more information on the protection of AMI devices.

SECTION 6 - PROSECUTION, PROGRESS AND ACCEPTANCE OF WORK

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

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

ADD:

6-3.2.1.1 Environmental Document.

1. The City of San Diego Development Services Department has prepared a Final Mitigated Negative Declaration for **La Jolla Country Reservoir and Pump Station Project**, as referenced in the Contract Appendix. You shall comply with all requirements of the Mitigated Negative Declaration as set forth in **Appendix A**.
2. Compliance with the City’s environmental document shall be included in the Contract Price, unless separate bid items have been provided.

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.

6-8.3.1 Defective Work. To the “WHITEBOOK”, item 6, DELETE in its entirety and SUBSTITUTE with the following:

6. For Building Projects which require a certificate of occupancy, not including sewer and water facilities, if you fail to correct the defective Work listed on the City’s Punch list within 45 Days after the Contract Time, you shall reimburse the City for all costs to provide inspection services required to monitor Work beyond the 45 Days. The City shall bill you for the additional inspection at the City’s established rates.

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.

7-3.2.5 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.

- 7-3.5.4.2 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. 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. 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

2. 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 City Supplement, ADD the following:

2. The City will obtain, at no cost to you, the following permits:
 - a) Building Permit PTS No. 438610

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.

ADD:

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 9 - MEASUREMENT AND PAYMENT

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 203 – BITUMINOUS MATERIALS

203-3.4.4 RUBBER POLYMER MODIFIED SLURRY (RPMS). To the "WHITEBOOK", ADD the following:

1. RPMS shall be used on this Contract.

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.

SECTION 302 – ROADWAY SURFACING

302-4.12.4 Measurement and Payment. To the "WHITEBOOK", item 2, Bid Description Table, ADD the following:

BID DESCRIPTION	UNIT
Rubber Polymer Modified Slurry (RPMS) Type I Over Type III and Striping	SF

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 304 –METAL FABRICATION AND CONSTRUCTION

304-5 PAYMENT. To the "WHITEBOOK", REVISE section "304-5" to "304-6".

SECTION 306 – OPEN TRENCH CONDUIT CONSTRUCTION

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

- a) Specified test pressure for Class 235 pipe shall be 150 psi.

- b) Specified test pressure for Class 305 pipe shall be 200 psi.

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

LA JOLLA COUNTRY CLUB PUMP STATION

TECHNICAL SPECIFICATIONS

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SECTION 01010 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 PROJECT BACKGROUND

The La Jolla Country Club Country Club Reservoir & Pump Station project was prompted by the need for a seismic upgrade and capacity increase at the existing facility that was originally constructed in 1928. The project is intended to improve reliability for this pump station that serves as a backup to the Soledad Reservoir and Pump Station that provides primary service to the 925 and 725 Pressure Zones in the La Jolla Area. Once the La Jolla Country Club Reservoir and Pump Station are operational, the City can pursue replacement of the aging Soledad Pump Station and Reservoir. Due to site constraints, the existing trapezoidal bottom reservoir will be replaced with a vertical wall reservoir in order to provide the necessary volume.

1.2 PROJECT DESCRIPTION –The Project includes construction of bypass servicing piping for the 725 pressure zone, demolition and salvage / recycling / disposal of the existing pump station and reservoir, and construction of new reservoir and pump station facilities, emergency portable generator, security and surveillance systems, site improvements including fencing, grading, and landscaping, permanent BMPs, and all other required work specified in the Contract Documents for a complete and functional system. The Contractor shall coordinate with City to relocate bypass piping, SCADA equipment, security and surveillance systems, fencing and all other required work specified in contract documents, and otherwise provide for the uninterrupted water service to the 725 and 925 pressure zones via other water supply facilities

1.3 OPERATION OF THE EXISTING FACILITY

The City's Water Operations Department will operate and maintain the existing pump station until such time as the replacement station has completed its operational performance testing period and is ready to be placed into full-time service. At this time, the existing station will be available for demolition and the Water Department Operations will assume day-to-day operational responsibility of the new station.

1.4 WORK COVERED BY THE CONTRACT DOCUMENTS

The WORK covered by these CONTRACT DOCUMENTS includes planning, design, construction, permits, start-up and testing of the facilities. The CONTRACTOR'S responsibility shall include compliance with the following, but not limited to:

- a. CONTRACT DOCUMENTS
- b. Approved CONTRACT DOCUMENTS
- c. Building Permits

SECTION 01010 – SUMMARY OF WORK

- d. Regulatory Agency Permits
- e. Public Utilities Department Guidelines and Standard Specifications

1.5 CONSTRUCTION SUBMITTALS

The CONTRACTOR shall provide construction submittals in accordance with the general requirements specified in Section 01300, and the specific requirements within the technical specification sections of the CONTRACT DOCUMENTS.

1.6 PROJECT START-UP

The CONTRACTOR shall perform start-up procedures, as specified in Section 01660 Facility Start-up and Operator Training.

1.7 OPERATOR TRAINING

The CONTRACTOR shall conduct vendor-training sessions with City of San Diego Operations and Maintenance personnel, as required in Section 01660, Facility Start-up and Operator Training.

1.8 OPERATION AND MAINTENANCE MANUALS

The CONTRACTOR shall prepare and submit Operations and Maintenance Manuals in accordance with requirements in Section 01300 - Submittals.

1.9 WORK SEQUENCE

The CONTRACTOR shall anticipate performance of the work in the following sequence:

1. Mobilize
2. Install pump station bypass piping and valving to maintain the 725 pressure zone in service throughout the contract.
3. Clear and grub and salvage / demolish building and reservoir.
4. Install shoring to protect existing fencing and building to west of site against damage from reservoir construction.
5. Stabilize soil / rough grade site / excavate footings and deepened reservoir
6. Install yard piping and subdrainage
7. Install below ground utilities and stickups
8. Form concrete footings
9. Form reservoir walls and any retaining walls
10. Build structures

SECTION 01010 – SUMMARY OF WORK

11. Install mechanical and electrical components and final architectural treatments
12. Perform functional testing, put in service, prepare O&M Manuals and conduct staff training.
13. Perform finish grading and landscaping
14. Complete punchlist and final acceptance

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

****END OF SECTION****

SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 - GENERAL (Not Used)

PART 2 – MATERIALS

2.1 GENERAL (MEASUREMENT)

Measurement for unit price quantities shall be based upon the appropriate bid item in the proposal. The actual quantity of measurement shall be as constructed by the Contractor in place in conformance with the Plans and Specifications.

2.2 LINEAR MEASUREMENTS

Pipeline and related facility measurements shall be made horizontally along the centerline of the pipeline and related facilities through tees, bends, valves, fittings, and as shown on the Plans for its limits or as otherwise specified in the Special Technical Provisions.

2.3 AREA MEASUREMENTS

Measurement for bid items involving area units shall be based upon the surface area measured in acres, square yards, square feet, or as indicated in the bid item.

2.4 VOLUME MEASUREMENTS

Measurement for bid items involving volume units shall be based upon the volume measured in cubic yards, tons, or as indicated in the bid item.

2.5 UNIT MEASUREMENTS

Measurement for bid items involving units of the item shall be based upon the number of units counted as indicated in the bid item.

2.6 LUMP SUM MEASUREMENT

Lump sum items shall include all labor, delivery, materials, equipment and testing services as required by these Specifications for the complete installation of the bid items described in this Section . No separate payment shall be made for items not included by the Contractor in the total contract Bid Price as described in Part 3 herein.

PART 3 – EXECUTION

3.1 GENERAL

A. This section covers methods of measurement and payment for items of work under this Contract. The total Bid Price shall cover all work required by the Contract Documents. All costs in connection with the proper and successful completion of the work, including furnishing all materials, equipment, tools and incidentals; and performing all necessary labor and supervision to fully complete

SECTION 01025 – MEASUREMENT AND PAYMENT

the work, shall be included in the unit (linear, area, volume) and lump sum prices bid. All work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid.

3.2 ESTIMATED QUANTITIES

- A. All estimated quantities stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the bids submitted for the work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefor.

3.3 BID ITEMS

- A. MOBILIZATION/DEMobilIZATION - Lump Sum Bid Item shall include full compensation for mobilization and demobilization including and not limited to furnishing and installing, complete and in place all the necessary preparatory work and operations, including those necessary for movement of personnel, equipment, supplies, and incidentals to the project site for the establishment and upkeep of temporary facilities, sanitary facilities, permits (unless otherwise specified in other Bid Items), traffic control plans, maintenance of project site including trash and litter pickup, offices, buildings, and other facilities necessary for work on the project, final project close-out and cleanup operations, including, but not limited to, those necessary for the removal of equipment, supplies, incidentals and debris from the project site, cleaning the streets and sidewalks of all soils and construction debris, record drawings, correction of deficiencies in the work, and for all other work required as indicated in the CONTRACT DOCUMENTS.
- B. WATER POLLUTION CONTROL PROGRAM DEVELOPMENT AND IMPLEMENTATION – Lump Sum bid item shall include full compensation for development and implementation including permit fees of the Project's water pollution control program, and as referenced in SSPWC per 7-8.6.4.2.
- C. DEMOLITION - PUMP STATION AND RESERVOIR - Lump Sum bid item shall include full compensation for demolition of the pump station and reservoir including and not limited to all walls, slabs, footings, floors, roofs, pumping systems and piping inside and outside of the pump station, and piping systems under the reservoir, electrical equipment and instrumentation, and protection of off-site properties as indicated in the Contract Documents. Bid item includes full compensation for all equipment, materials, labor, and all hauling of materials to required locations for disposal, disposal costs and fees, if any required as indicated in the Contract Documents.

SECTION 01025 – MEASUREMENT AND PAYMENT

- D. SHEETING AND SHORING – Lump Sum Bid Item shall full compensation for all equipment, materials, labor to install sheeting and shoring complete and in place. The Bid Item Price shall include all work related to the installation of the sheeting and shoring including, but not limited to, meeting all OSHA requirements and as required for the construction of the pump station and reservoir, site improvements, yard piping, manholes, drainage piping, site improvements, protection of off-site properties, and preparation and approved sheeting and shoring plan, and any other work as required by the CONTRACT DOCUMENTS.
- E. STRUCTURAL EXCAVATION/HAULING – Unit cost Bid Item includes full compensation for all equipment, materials, labor to perform structural excavation including stockpiling and hauling of all materials to required locations for disposal, disposal costs, and fees, if any, and any other work required required in the CONTRACT DOCUMENTS.
- F. PUMP STATION – Lump Sum Bid Item shall include full compensation for all equipment, materials, labor to install the pump station as indicated on plans and as required on CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to sub-grade preparation, bedding, compaction, floor drains, geotextile fabric, cast-in-place pump station building including, but not limited to, foundation, floor, walls, slab-on-grade landings, waterproofing; roof walkway, mechanical piping and fittings including but not limited to piping through the walls, pipe supports, valves, pipe couplings, dismantling joints, pipe taps, hose bibbs, architectural features including acoustical louvers, acoustical panels, glazing, doors, hardware, skylights, masonry walls, roof, floor grates, fans, air conditioner, exhaust fans, duct work; and tile roof, vertical turbine pumps including motors, pump cans, pump head, and pump appurtenances, all required equipment testing, inspections, disinfection and bacteriological testing, and all work as indicated in the CONTRACT DOCUMENTS.
- G. RESERVOIR – Lump Sum Bid Item shall include full compensation for all equipment, materials, labor to install the cast-in-place reservoir as indicated on plans and as required on CONTRACT DOCUMENTS. The Price for this bid Item shall include all work related to sub-grade preparation, bedding, compaction, PVC underdrains, PVC wall drain, expoy lining, geotextile fabric, cast-in-place reservoir including, but not limited to, foundation, walls, and roof; pedestrian walkway along reservoir, handrall on reservoir, waterproofing, inlet/outlet pipe penetrations, reservoir sub-drain and reservoir drain manholes including but not limited to, manhole covers, grade rings, adjustment of manhole covers to finished grade, manhole waterproofing and lining, piping within the manhole, piping penetrations, submersible pump and appurtenances, ladder, pump rails; sampling pump and appurtenances, all required equipment testing, inspections, disinfection and bacteriological testing, and all work as required in CONTRACT DOCUMENTS.

SECTION 01025 – MEASUREMENT AND PAYMENT

- H. STRUCTURAL BACKFILL - Unit Cost Bid Item shall include full compensation for all equipment, materials, labor to install the structural backfill complete and in place as indicated on plans and as required in the CONTRACT DOCUMENTS. The Price for this Bid Item shall include backfill, imported backfill, if required, testing, compaction, and controlled low strength material.
- I. SITE IMPROVEMENTS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the site improvements as indicated on plans and as required on CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to coarse and final grading, curb and gutter, asphalt concrete paving, bollards, metal fencing, metal access gates, yard piping including but not limited to ductile iron pipe and fittings, welded steel pipe and specials, PVC pipe, all valves, mechanical joints, bends, tees, valve cans, standpipe, drains, coupling/adapters; remove and replace landscaping, irrigation system, altitude valve vault including, but not limited to, pre-cast vault, altitude valve, pipe supports, ladder, hatch, SDGE&E transformer pad, portable diesel generator concrete pad, all required pipe and equipment testing, disinfection and bacteriological testing, and all other accessories as indicated in the CONTRACT DOCUMENTS.
- J. SURVEILLANCE SECURITY SYSTEM - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the security system as shown in the CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to cameras, card readers, swing gate opener, vehicle detector, magnetic gate locks, mounting posts, camera mounting poles, conduits, SCADA interface, and all other accessories as indicated in the CONTRACT DOCUMENTS.
- K. ELECTRICAL AND INSTRUMENTATION - Lump Sum Bid Item shall include full compensation for all equipment, materials, labor to install the electrical and instrumentation as indicated on plans and as required on CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related conduits, wiring, electrical cabinets, VFDs, reduced voltage soft starter, motor control center, electrical panel boards, control panels, surge arrestors, programmable logic controllers, grounding, cables, lighting fixtures and appurtenances, convenience boxes, junction boxes, cables, pipe/conduit supports, SCADA equipment, radio, antennas, level indicators, level transducers and transmitters, pressure gauges, pressure transducers and transmitters, surveillance security equipment, intrusion switches, cleanup, testing, and all other accessories as indicated in the CONTRACT DOCUMENTS.
- L. DIESEL GENERATOR SET - Lump Sum Bid Item shall include full compensation for all equipment, materials, labor for the diesel generator set as indicated on plans and as required on CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to the diesel generator, including but not limited to, trailer-mounted engine-generator and appurtenances, sound enclosure, silencers, battery, battery rack, battery charger, radiator, fans, belts, hoses, fuel

SECTION 01025 – MEASUREMENT AND PAYMENT

system, diesel fuel, automatic transfer switch, seismic isolators, lubrication system, governor, gauges, instrumentation, ACPD Permit, Certifications, testing, and all other accessories as indicated in the CONTRACT DOCUMENTS.

- M. SCADA EQUIPMENT ACCOUNT - Allowance Bid Item shall include full compensation for all equipment, materials, labor for assisting the City with Temporary SCADA equipment as indicated on plans and as required on CONTRACT DOCUMENTS. The Bid Allowance for this Bid Item shall include work related to assisting the City with Installation of temporary SCADA facilities as identified in Section 01040 - Coordination. The allowance requires that the CONTRACTOR shall maintain a detailed record, accounting for each labor hour, material quantity, and equipment hour that is charged against the SCADA allowance.
- N. OVEREXCAVATION/RECOMPACTION - Allowance Bid Item shall include full compensation for all equipment, materials, labor for overexcavation/recompaction of soil as directed by the RESIDENT ENGINEER. The Bid Allowance for this Bid Item shall include work related to overexcavation/recompaction of soils when unsuitable material is found and was not identified on the plans. The allowance requires approval from the Resident Engineer, and in accordance with Section 3-3 of the SSPWC. The allowance is an estimate for the purposes of comparing Bids. The amount paid shall be based on actual quantities furnished, installed disposed, or constructed in accordance with the CONTRACT DOCUMENTS.
- O. ARCHEOLOGICAL AND NATIVE AMERICAN MONITORING PROGRAM - Allowance Bid Item shall include full compensation for all equipment, materials, labor for monitoring of archeological and Native American artifacts during excavation as indicated on plans and as required on CONTRACT DOCUMENTS and as referenced in SSPWC 6-3.2.2.1
- P. PALEONTOLOGICAL MITIGATION AND EXCAVATION - Allowance Bid Item shall include full compensation for all equipment, materials, labor for monitoring for paleontological artifacts during excavation and mitigation requirements as indicated on plans and as required on CONTRACT DOCUMENTS. and as referenced in SSPWC 6-3.2.3.1.
- Q. PERMANENT STORM WATER BEST MANAGEMENT PRACTICES - Lump Sum Bid Item shall include full compensation for all equipment, materials, labor to demolish and install the permanent storm water BMPs as indicated on plans and as required on CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to sub-grade preparation, bedding, compaction, sub drains, clean outs, geotextile fabric, cast-in-place cut off walls, compact proprietary biofiltration BMP, permeable concrete interlocking pavers, aggregate, sand, amended soils, rip-rap, curb outlet, all required equipment testing, and as indicated on sheets C-14 and C-15 in the contract documents.

SECTION 01025 – MEASUREMENT AND PAYMENT

- R. SPECIAL INSPECTION - The Allowance bid item for Soils Investigation Type I includes full compensation for all equipment, materials, labor as required in the CONTRACT DOCUMENTS and as directed by RESIDENT ENGINEER if needed as described in SSPWC 4-1.3.4.1 and 9-3.1. The allowance requires that the CONTRACTOR maintain a detailed record, accounting for each labor hour and equipment hour that is charged against Soils Investigation allowance.
- S. ROCK EXCAVATION – Unit Cost Bid Item shall include full compensation for all equipment, materials, and labor to excavate and remove rock encountered at the project site and all accessories as described in Section 2200-Earthwork, and in CONTRACT DOCUMENTS.
- T. FINAL OPERATIONS & MAINTENANCE (O&M) MANUALS - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to complete all approvals of the O&M Manuals as indicated on plans and as required in CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to Final acceptance CONTRACT DOCUMENTS.

****END OF SECTION****

SECTION 01040 – COORDINATION

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall coordinate work under the Contract and work by others on the Project including, but not limited to, the following:
 - 1. General construction coordination and administration procedures.
 - 2. Work required by City Forces.
 - 3. Work required by Utility Companies and Utility Company Contractors.
- B. The CONTRACTOR shall take precautions necessary to assure that no damage or unscheduled shutdowns occur to any facilities, including piping, utilities, traffic signals, roads, and structures, that are to remain in operation and are not to be modified or replaced. It is the CONTRACTOR'S responsibility to contact Underground Service Alert, (800-422-4133), a minimum of two (2) days prior to any excavation for verification and location of utilities and notification of commencement of work. Any temporary facilities, materials, equipment and labor required to achieve this objective shall be provided by the CONTRACTOR at his own expense. At the completion of work, all such temporary facilities, materials, and equipment remaining shall be removed from the site.
- C. Regarding connection to existing buried piping and facilities at or adjacent to the site, it shall be the responsibility of the CONTRACTOR to uncover and verify their locations, elevations, materials, and dimensions prior to beginning construction or fabrication of any new materials or facilities which are dependent on the location of existing facilities.

1.2 RELATED SECTIONS

- A. The Work of the following Sections 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 01010 - Summary of Work.
 - 2. Section 01300 - Submittals.
 - 3. Section 13310 - Instrumentation and Control.
 - 4. Section 16050 – Basic Electrical Materials and Methods
 - 5. Section 16485 – Local Control Panels

1.3 GENERAL COORDINATION

SECTION 01040 – COORDINATION

- A. All communication for this project shall be coordinated with the RESIDENT ENGINEER.
- B. Coordinate construction operations to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - 3. Make provisions to accommodate items scheduled for later installation.-
- C. The work shall be carried on at such places on the project and also in such order or precedence as may be found necessary by the RESIDENT ENGINEER to expedite the completion of the project and accommodate community commitments. After work has begun on any part of the project, it shall be carried forward to its final completion, unless otherwise determined by the RESIDENT ENGINEER.
- D. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the RESIDENT ENGINEER.
- E. Staff Names: Within 15 working days of Notice to Proceed, submit a list of the CONTRACTOR'S principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.
 - 1. Post copies of the list in the Project meeting room, the temporary field offices, and each temporary telephone.

1.4 WATER SYSTEM SHUTDOWNS

- A. Any proposed shutdowns must be indicated on the CONTRACTOR'S Detailed Construction Schedule to be submitted for review by the RESIDENT ENGINEER per Section 6-1 of the SSPWC and the City's Supplemental Standards for Public Works Construction (Whitebook).
- B. The CONTRACTOR shall coordinate with RESIDENT ENGINEER for all activities requiring the shutdown, depressurizing, draining, testing, or returning to service of any City water system facility. Such coordination requirements shall include but not be limited to the City Water Department and Water Quality Laboratory.

SECTION 01040 – COORDINATION

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

1.5 COORDINATION WITH CITY OF SAN DIEGO COMMUNICATIONS/SCADA EQUIPMENT

The CONTRACTOR shall provide manpower and equipment to assist the City with disassembly, temporary relocation and setup, and reinstallation of miscellaneous Supervisory Control and Data Acquisition (SCADA) equipment, including but not limited to antennas, radio gear, and related equipment at the site.

The Work requires that City forces will be actively involved with the work described herein, but they will need assistance of CONTRACTOR labor and equipment on a "forced account" basis. CONTRACTOR shall establish a schedule for labor and equipment rates to be used to accomplish these tasks in assisting City forces, subject to approval by the RESIDENT ENGINEER. Then, as the City forces make a request for labor and equipment, the CONTRACTOR shall maintain a detailed accounting of the labor and equipment hours to accomplish the necessary tasks and submit to the RESIDENT ENGINEER for approval.

For all equipment provided for this work provide submittals per Section 01300 – Submittals.

A. Antennas

1. Existing Antenna Inventory - There are nine existing antennas or rods located on the site that generally need to remain in service throughout the course of construction. Some of the equipment within the existing pumping station is linked to the operation of these antennas. The antennas will be referred to with the following names, which are also shown on the construction Drawings.
 - a. SCADA Potable Water Rod. The important portion of this antenna mast is the top four feet.
 - b. VHF Tall Rod. Reportedly this antenna can be moved up to 15-20 feet during construction.
 - c. Pronet Short Rod. This antenna is currently attached to the bottom of the VHF rod.
 - d. SCADA Wastewater Rod. The important portion of this antenna mast is the top four feet.
 - e. Yagi Wastewater Antenna. This antenna transmits data to Metro Operation Center Wastewater.

SECTION 01040 – COORDINATION

- f. Yagi Radio Antenna.
- g. Wastewater Rod.
- h. Yagi Antenna – Radio – actually two antenna currently mounted to the roof of existing pumping station building which can be temporarily removed and stored during the construction of new facilities.

2. Relocation During Construction, and After Construction:

- a. During construction each of the existing antennas, except for the two located on the roof of existing pumping station, must be temporarily relocated to a location that will allow the antenna to function, but be sufficiently relocated to avoid hindering construction. City forces will work with CONTRACTOR to determine sites that are acceptable to CONTRACTOR to avoid interfering with construction, while at the same time be sufficient to transmit signals as desired. Antenna may be moved along with their support mast, or utilize other temporary support mast, site perimeter fencing, or other suitable support.
- b. At the completion of construction, City staff may desire that antennas be relocated, again, to a more permanent location, or a location with improved reception. For example, they may be moved back to the new perimeter fence, using old or new mast. Other antenna may require their own pole mounting, following City Standard detail I-629.

B. SCADA Metal Cabinet of the Water Department:

- 1. Inside the existing pump station is the SCADA equipment of the Water Department inside a metal cabinet approximately 18 inches square by 42 inches in height. This cabinet must be kept in service during construction (except when it is being temporarily relocated) by moving it to a temporary location, and at the completion of construction it will be moved into the new pumping station. A temporary cabinet is to be provided on the site for relocating this metal cabinet during construction. It has an electrical load of 3 units each 2 amps at 120 volts. This metal cabinet requires access from the front of the cabinet as well as the back of the cabinet.
- 2. This cabinet has three incoming antenna cables connected to three different antennas. These include the datalink radio 97-10-B (NBS), the bottom diagnostic link radio 980-10, and the master 97-90.

C. Radio Cabinet of Public Works Environmental Services:

SECTION 01040 – COORDINATION

1. A second metal cabinet in the existing pump station is approximately 18 inches square by 48 inches in height. It is a VHF cabinet (Tate) and two MDS Model P20 for the SCADA system. This cabinet is only accessible from the front and it is normally locked. It has a power load capability for five (5) VHF receivers.
2. This cabinet includes the master controls for components of the City wastewater system, mostly consisting of remote sewage pumping (lift) stations status, etc.

D. Panel Mounted Equipment:

1. An existing wood panel on the west wall of the pumping station is approximately 4 feet by 8 feet. The equipment that must be retained encompasses approximately the left $\frac{3}{4}$ of the panel, or about 4 feet by 6 feet dimension.
2. The equipment that must be retained consists of phone lines, panel mounted, and miscellaneous monitoring equipment. The signals are sent via phone lines to the Soledad Reservoir complex and then distributed via microwave to the other parts of the system, including the CITY SCADA Central.

E. Radio Repeater:

1. This cabinet is set at grade in the northeast corner of existing reservoir lid.
2. The radio repeater cabinet is an integral part of the SCADA system at the reservoir site and is responsible for sending and receiving signals to other parts of the SCADA system.
3. This cabinet must be temporarily relocated during construction.

1.6 UTILITY COORDINATION

A. New Service

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

B. Existing Facilities

SECTION 01040 – COORDINATION

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

PART 2 -- PRODUCTS

2.1 TEMPORARY CABINET

In order to temporarily house the equipment listed above during construction, a temporary cabinet must be brought to the site.

The size of the cabinet is to be at least 4 feet by 6 feet dimension, weatherproof, with a floor, and lockable. The power company has been requested to provide a temporary electrical service to this cabinet. City shall make arrangements to rent or purchase a cabinet of suitable size and have it delivered to the site. The cabinet shall have a 60A, 120/240 V, 12 pole, 3 wire load center with 60A main circuit breaker plus minimum (4) 20A, 1P circuit breakers for City cabinets and outlets.

PART 3 -- EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

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

3.2 COORDINATION WITH SCADA WORK

- A. Temporary Cabinet. CONTRACTOR shall clear a small space near the front of the site as shown on the Drawings, place a temporary "foundation", if required, and place the temporary cabinet. CONTRACTOR shall coordinate with the power company to receive the temporary power feed with a main breaker.
- B. Routing Cables to temporary SCADA cabinet and final electrical room.
 1. Cables Required:
 - a. Each of the antennas will require a hard cable to be placed from the antenna temporary location to the temporary SCADA cabinet during construction. CONTRACTOR may assume that the City will provide the cable, but CONTRACTOR assistance may be required to lay the cable from temporary antenna locations to the temporary cabinet,

SECTION 01040 – COORDINATION

and make connections to bring the SCADA equipment online. CONTRACTOR shall place cables at the location of his choosing, out of the way of his construction plan insofar as possible, and be responsible during construction to avoid cutting or breaking the cables.

- b. At the completion of construction, the City will direct the desired permanent location for the onsite antennas. Then final cabling will be required, with CONTRACTOR assistance, between the antennas and the cabinets and panel that will be located inside the new pumping station.

**** END OF SECTION ****

SECTION 01090 – REFERENCES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

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

1.2 SCHEDULE OF REFERENCES

- A. AASHTO-American Association of State Highway and Transportation Officials
444 North Capitol Street, N.W.
Washington, DC 20001
- B. ACI-American Concrete Institute
Box 19150
Redford Station
Detroit, MI 48219
- C. AI-Asphalt Institute Asphalt Institute Building
College Park, MD 20740
- D. AISC-American Institute of Steel Construction, Inc.
400 North Michigan Avenue
Eighth Floor
Chicago, IL 60611
- E. AISI-American Iron and Steel Institute
1000 16th Street, N.W.
Washington, DC 20036
- F. ANSI-American National Standards Institute
1430 Broadway
New York, NY 10018
- G. ASME-American Society of Mechanical Engineers
345 East 47th Street
New York, NY 10017
- H. ASTM-American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

SECTION 01090 – REFERENCES

- I. AWWA-American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235
- J. AWWPA-American Wood-Preservers' Association
7735 Old Georgetown Road
Bethesda, MD 20014
- K. AWS-American Welding Society
550 LeJeune Road
Miami, FL 33135
- L. FS-Federal Specification
General Services Administration
Specifications and Consumer Information Distribution Section (WFSIS)
Washington Navy Yard, Bldg. 197
Washington, DC 20407
- M. IEEE-Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017
- N. DIMIAC-International Masonry Industry All-Weather Council
International Masonry Institute
815 15th Street, N.W.
Washington, DC 20005
- O. ISA-Instrument Society of America
P.O. Box 12277
Research Tri Park, NC 27709
- P. LPI-Lighting Protection Institute
P.O. Box 406
Harvard, IL 60033-0406
- Q. MIL-Military Specification
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120
- R. NEC-National Electric Code
See NFPA
- S. NEMA-National Electrical Manufacturers' Association
2101 L Street, N.W.
Washington, DC 20037

SECTION 01090 – REFERENCES

- T. NFPA-National Fire Protection Association
Battery March Park
Quincy, MA 02269
- U. OSHA-Occupation Safety and Health Administration
U. S. Department of Labor
Washington, DC
- V. PCA-Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077
- W. PCI-Prestressed Concrete Institute
210 North Wacker Drive
Chicago, IL 60606
- X. SDI-Steel Door Institute
712 Lakewood Center North
Cleveland, OH 44107
- Y. SSPC-The Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
- Z. UL-Underwriters Laboratories, Inc.
333 Pefingston Road
Northbrook, IL 60062

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01300 –SUBMITTALS

PART 1 - GENERAL

1.1 DELIVERABLES

SHOP DRAWINGS

- A. Wherever called for in the CONTRACT DOCUMENTS, the CONTRACTOR shall furnish two (2) copies, plus one reproducible copy, of each shop drawing submittal to the RESIDENT ENGINEER. Prior to submittal to the RESIDENT ENGINEER, each shop drawing submittal shall be certified by an authorized representative of the CONTRACTOR. The RESIDENT ENGINEER will review shop drawings and will utilize the approved shop drawing submittals as a basis for inspecting the work pertaining to the shop drawing submittal. No work on a particular item shall commence until the shop drawing for that item has been reviewed and approved by the RESIDENT ENGINEER. No payment for any item of work shall be made until the shop drawing for that item of work has been submitted to the RESIDENT ENGINEER.
- B. 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 other submittal requirements indicated by the technical specifications. The CONTRACTOR shall submit, as applicable, the following for all prefabricated or manufactured structural, mechanical, electrical, plumbing, and process systems and equipment:
1. Wiring and control diagrams of systems and equipment.
 2. Complete manufacturer's specifications, including materials description and paint system.
 3. Samples of finish colors for selection.
 4. Requirements for storage and protection prior to installation.
 5. Installation procedures.
 6. List of all requested exceptions to the CONTRACT DOCUMENTS and/or variations from the specified equipment.
- C. All shop drawing submittals shall be accompanied by the RESIDENT ENGINEER'S standard submittal transmittal form. The form may be obtained in quantity from the RESIDENT ENGINEER. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.
1. Sequentially number the transmittal forms. Resubmittals shall have original number with an alphabetic suffix.

SECTION 01300 –SUBMITTALS

2. Identify Contract, CONTRACTOR, Sub Contractor, and/or Supplier; pertinent drawing sheet and detail number(s), as appropriate. On standard drawings or data sheets, clearly indicate model and option being proposed and strike out all non-relevant data.
 3. All submittals must be capable of being scanned electronically for filing on a computer file.
- D. 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 RESIDENT ENGINEER.
- E. Fabrication of a manufactured item or field installation shall be commenced only after the RESIDENT ENGINEER has reviewed and approved the shop drawing submittals.
- F. All CONTRACTOR shop drawing submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR, prior to submission to the RESIDENT ENGINEER. 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. All non-certified submittals will be returned to the CONTRACTOR, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- G. 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 adequacy of connections and details.
- H. Any deviations from the Technical Specification shall be noted by the Engineer of Record and submitted to the RESIDENT ENGINEER for approval.

1.2 SAMPLES

- A. Whenever, in the CONTRACT DOCUMENTS, samples are required, the CONTRACTOR shall submit not less than 4 samples of each such item or material to the RESIDENT ENGINEER for review.
- B. Samples, as required herein, shall be submitted for acceptance a minimum of 30 days prior to ordering such material for delivery to the job site, 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.

SECTION 01300 –SUBMITTALS

- C. All samples submitted to the OWNER'S REPRESENTATIVE shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and the Manufacturer's name for identification. Upon acceptance, 2 sets of the samples will be returned to the CONTRACTOR. One set of samples will be retained by the RESIDENT ENGINEER at the off-site office, and one set of samples shall remain at the job site with the RESIDENT ENGINEER 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.

1.3 OPERATIONS AND MAINTENANCE MANUALS

- A. General: The CONTRACTOR shall prepare Operations and Maintenance manuals (O&M Manuals) in accordance with the criteria specified in this section and Book 8 of the City's Design Guidelines
 - 1. Terminology: the words described below, when used in the context of the O&M Manuals shall have the associated meaning:
 - a. O&M Manual: the complete set of Volume I, Volume II and Volume III of the O&M Manual for this facility.
 - b. OPERATIONS MANUAL: the complete set of Volume I and Volume II of the O&M Manual for this facility. Volume I will contain process information. Volume II will contain standard operating procedures.
 - c. MAINTENANCE MANUAL: the complete Volume III of the O&M Manual which contains all of the maintenance information for this facility.
 - d. Volume: any of the complete sets of information comprising the specific OPERATIONS MANUAL and the specific Maintenance Manual. Each Volume may contain one or more Parts.
 - e. Part: a Part is wholly contained within one binder. Each Part may contain one or more Sections. If any Volume is too thick for a single binder, it shall be divided into Parts, with each Part in a binder.
 - f. Section: a subdivision of any Volume.
 - g. Subsection: a subdivision of any Section.

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2. Organization:
 - a. The O&M Manual shall be divided into three separate Volumes as described below.
 - b. If a Volume exceeds the maximum 2-inch or 300-page requirement, then it shall be split into two or more Parts.
 - c. If a Volume is split into Parts, the split must occur between Sections and not within a Section.
 - d. Each Part shall not exceed 2 inches or 300 pages in size.
 - e. Volumes shall be numbered using Roman numerals, I, II, and III.
 - f. Parts will be lettered using capital letters; A, B, C..., AA, BB, etc.
 - g. Sections within each Part shall be separated with a tabbed divider on heavy card stock, with each page uniquely numbered (e.g. 1 -1, 1-2 ,..., 2-1, 2-2, etc.,).
 - h. Subsections shall be separated by a colored sheet of paper indicating the title of the Section and Subsection.
 - i. Appendices shall be located at the end of the Volume in which they are referenced.

3. Content:
 - a. All data contained within the O&M Manuals must be clear and legible; facsimiles or copies of facsimiles will not be accepted.
 - b. No color reproduction is allowed.
 - c. Lettering for drawings shall be no less than 1/8 inch in size.

B. Volume I of the O&M Manual, Process Information Manual:

1. General: Volume I and Volume II of the O&M Manual will comprise the OPERATIONS MANUAL. All information presented in the OPERATIONS MANUAL shall be directed at the operations staff assigned to the facility. The information will allow the operations staff to startup, operate, and shutdown the equipment and processes used in the facility.
2. Format: The standard section format for each process shall be composed of four main subsections: Introduction, Process Components and Operation, Process Analysis and Control, and Safety.

SECTION 01300 –SUBMITTALS

3. Content:
 - a. INTRODUCTION AND OVERVIEW: Each section shall begin with at least a two-paragraph introduction. The first paragraph will state the purposes of the process and will discuss briefly the theory or concept of the process. The second paragraph will be a brief description of the process and its relationship with other processes.
 - b. COMPONENTS, OPERATION, AND CONTROLS: This section shall present a description of each system components, description of system operations, description of system controls, description of auxiliary and support system, and equipment design information.
 - c. SAFETY PROCEDURES AND PRECAUTIONS: This section shall describe safety items, warnings, and suggestions, lockout/Tagout Policy and procedures, precautions when working around the equipment or system, and possible safety hazards (e.g., confined spaces, chemicals, tripping hazards, etc.)

C. Volume II of the O&M Manual, Standard Operating Procedures:

1. General: A Standard Operating Procedure (SOP) is a detailed statement of actions which must be performed to properly operate a unit process within a specific treatment process as well as the associated parts of the entire treatment process.
2. Format: See Book 8 for formatting requirements.
3. Content:
 - a. TROUBLE SHOOTING PROCEDURES: this Subsection shall start with a tabular list of all safety precautions associated with the SOP. These can include confined spaces, chemical safety for specific chemicals, electrical hazards, mechanical hazards, lifting safety, etc. Following the tabular list will be a detailed discussion of each safety precaution.
 - b. PRE-STARTUP PROCEDURES: The troubleshooting guide identifies orderly, step-by-step procedrues for normal work before individual pieces of equipment or a system are started.
 - c. STARTUP PROCEDURES: The normal startup mode should be confirmed with the OWNER and it will most likely be DCS controlled. The procedures shall list all of the manual operational tasks which need to be accomplished prior to the DCS taking over the operations.

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- d. ROUTINE OPERATIONAL PROCEDURES: This section shall itemize the routine responsibilities to be performed by the Operator. Reporting logs are to be developed by the CONTRACTOR and included in O&M Manual in Volume I.
 - d. SHUTDOWN PROCEDURES: The shutdown of the system shall be described step- by-step, in the order required to effect a smooth shutdown of the process. The procedures should include how to stop the equipment for short periods of time (minutes to hours) and for extended periods of time (days to months). The resultant effect on other equipment or processes shall be discussed. The final step should advise the Operator to lock out/tag out any units which are to be isolated for any reason.
 - e. OPERATIONAL PROCEDURES FOR ABNORMAL CONDITIONS: A description of abnormal conditions, such as equipment and power failures control system failures, annunciated alarm conditions, etc., shall be discussed. Total loss of each system within a process and the total loss of the process itself shall also be discussed.
- D. Volume III of the O&M Manual, Maintenance Manual Specifications:
- 1. General: The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the MAINTENANCE MANUAL. The MAINTENANCE MANUAL shall be written so that it can be used and understood by the OWNER'S operation and maintenance staff.
 - 2. Index:
 - a. The CONTRACTOR shall prepare a general index, contained in a separate binder at the beginning of Volume III. This index will indicate specification number, tag number, name, process application and MCC for each item of equipment. The electronic version of this index shall be sortable by any category.
 - b. Each MAINTENANCE MANUAL shall contain an index of the manufacturers and equipment that conforms to the eight "Sections" shown below. The sections of all MAINTENANCE MANUALS shall appear in the same order. If any section is not applicable to a piece of equipment. indicate as such on the index.
 - 3. Subdivisions: The MAINTENANCE MANUAL shall be subdivided into "Parts." first by manufacturer, and second by equipment name.

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Manuals will be arranged in alphabetical order by manufacturer's name. If a manufacturer provides more than one piece of equipment, the manuals will be arranged within each manufacturer's group of binders alphabetically by equipment name. "Sections" within each "Part" shall be separated with a tabbed divider on heavy card stock, with each page uniquely numbered (e.g. 1-1, 1-2 ,,,, 2-1,2-2, etc.), and conform to the following:

- a. Section 1 - Equipment Summary
 - (1) Summary: A summary sheet shall indicate the following:
 - (a) equipment name
 - (b) equipment number
 - (c) process area(s) in which the equipment is installed
 - (d) specification section number(s)
 - (e) Manufacturer/Vendor name, address, phone and facsimile numbers, e-mail address, and web site address
 - (f) Local Representative/service Provider name, address, phone and facsimile numbers, e-mail address, and web site address
 - (g) Material Identifier/Vendor Job Reference Number
 - (h) Brief description of site specific modifications (if applicable)
- b. Section 2 - Operational Procedures
 - (1) Procedures: Manufacturer-recommended procedures for the following shall be included in Section 2:
 - Installation
 - Adjustment
 - Start-up Location of controls, special tools or other equipment required Related instrumentation needed for operation
 - Operating Procedures

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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

c. Section 3 - Preventive Maintenance Procedures

- (1) 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.
- (2) Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade and type, and temperature ranges shall be covered.

d. Section 4 - Parts List and Exploded View Drawings

- (1) 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.
- (2) Drawings: Cross-sectional or exploded view drawings shall accompany the parts list.

e. Section 5 - Wiring Diagrams

- (1) Diagrams: Section 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

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- f. Section 6 - Shop Drawings
 - (1) Drawings: This Section shall include approved shop or fabrication drawings, complete with dimensions.
 - g. Section 7 - Safety
 - (1) Procedures: This Section describes the safety precautions to be taken when operating and maintaining the equipment or working near it.
 - h. Section 8 - Documentation
 - (1) All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this Section.
4. Data Sheet: For certain items designated during design, a Data Sheet, containing all of the information identified in the Equipment Summary above, shall be submitted in lieu of a complete MAINTENANCE Manual, along with Vendor supplied catalogues or literature. These items, such as ceramic tile or PVC non-pressure pipe, shall be identified with the input and direction of the OWNER'S REPRESENTATIVE and the OWNER during design phase.
- E. O&M Manual Submittal Requirements:
- 1. General:
 - a. BINDERS: Each manual shall be bound in a standard size, 3-ring, loose leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2 inches or 300 pages. Pages shall turn freely in the binders. If additional binders are required for a piece of equipment they will be clearly marked as 1 of 2, 2 of 2, etc. Manuals that must be divided among multiple binders shall be divided at logical points, and not in the middle of sections.
 - b. IDENTIFYING MARKS: Each binder shall be clearly labeled, identifying the Volume number and contents of the binder. For MAINTENANCE MANUALS, the name of the manufacturer and equipment name shall be clearly displayed vertically on the spine, from top to bottom.
 - 2. Operations Manual:
 - a. DRAFT: The CONTRACTOR shall furnish to the RESIDENT ENGINEER four (4) identical copies of a draft OPERATIONS

SECTION 01300 –SUBMITTALS

MANUAL, including preliminary figures and tables. no later than 75 percent completion of design.

- b. FINAL: The CONTRACTOR shall furnish to the RESIDENT ENGINEER four (4) identical copies of the OPERATIONS MANUAL, incorporating City comments as agreed, no later than 75 percent of construction completion date. All discrepancies found by the RESIDENT ENGINEER in the OPERATIONS MANUALS shall be corrected by the CONTRACTOR within 30 days from the date of written notification by the RESIDENT ENGINEER.

3. Maintenance Manual:

- a. The CONTRACTOR shall furnish to the RESIDENT ENGINEER four (4) identical MAINTENANCE MANUALS.
- b. MAINTENANCE MANUALS shall be submitted in final form, to the RESIDENT ENGINEER no later than the 75 percent of construction completion date. All discrepancies found by the RESIDENT ENGINEER in the MAINTENANCE MANUALS shall be corrected by the CONTRACTOR within 30 days from the date of written notification by the RESIDENT ENGINEER.
- c. Incomplete or unacceptable MAINTENANCE MANUALS at the 75 percent construction completion point shall constitute sufficient justification to withhold the amount stipulated in Section 01700 from any monies due the CONTRACTOR.
4. Electronic Submittal Requirements: The O&M Manuals shall be submitted in accordance with the electronic document submittal requirements described below.

1.4 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.

SECTION 01300 –SUBMITTALS

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 (1988) with Joliet extensions.
 5. Deviation from this standard will be accepted only if advance approval is given by the RESIDENT ENGINEER.
- B. Documents: Electronic submittals for the following types of documents are required as a minimum.
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
 - (a) Manufacturer O&M manuals
 - (b) Facility Loop and Wiring Diagrams
- C. Format:
1. Construction drawings and record drawings developed under the Contract shall be in Bentley Microstation (.DGN) format.
 2. Other than construction drawings and record drawings, documents shall be in Adobe Acrobat PDF format, using the Acrobat version as specified by the RESIDENT ENGINEER. Documents that are submitted in Acrobat Image Only format will not be accepted. All PDFs shall be submitted in searchable format in compliance with ADA requirements.
 3. Electronic Conversion: Vendor and CONTRACTOR shop drawings developed under the Contract shall be in Bentley Microstation (.DGN) format. Documents in electronic format (Wordperfect, Microsoft

SECTION 01300 –SUBMITTALS

Word, Excel, Lotus, etc.) shall be converted to searchable 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 searchable 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
- D. 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 RESIDENT ENGINEER. An example of information to be provided is as follows: (This is an example only)
 - (a) Document file name
 - (b) Document title and description
 - (c) Hard Copy Catalog No. (used by facility document coordinator)

SECTION 01300 –SUBMITTALS

- (d) Document Type: (see above)
- (e) Facility Name
- (f) Specification Number
- (g) Process Name
- (h) Unit Process Number
- (i) Manufacturer's Name (if applicable)
- (j) Supplier's Name (if applicable)
- (k) EMPAC asset number (if applicable)
- (l) Asset Description (if applicable)
 - (1) Keyword
 - (2) Qualifier

1.5 SPARE PARTS LIST

- A. The CONTRACTOR shall furnish to the RESIDENT ENGINEER copies 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 RESIDENT ENGINEER 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 labeled and bound in standard size, 3-ring, loose leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

PART 2 - PRODUCTS (Not Used)

SECTION 01300 –SUBMITTALS

PART 3 - EXECUTION

3.1 SCHEDULING FOR SUBMITTALS

- A. The CONTRACTOR is to recognize the time and sequence related to the submittals required by the contract documents. The CONTRACTOR will not be allowed additional contract time or compensation due to delays associated with submittals. In addition, the costs associated with expedited review of a submittal or a submittal conference may be withheld from monies due the CONTRACTOR by the RESIDENT ENGINEER to cover additional costs of the RESIDENT ENGINEER's review.

**** END OF SECTION ****

SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

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

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01300 Submittals
 - 2. Section 01660 Facility Start-up and Operator Training
 - 3. Section 01680 Physical Checkout, Shop, Field, and Functional Testing
 - 4. Section 01730 Operation and Maintenance Information
 - 5. Section 01750 Spare Parts and Maintenance Materials

1.3 SUBMITTALS

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

1.4 PRODUCT DELIVERY

- A. CONTRACTOR shall arrange, with the United States Postal Service, a special address for the project. All deliveries shall be made to that address. No deliveries will be accepted by the RESIDENT ENGINEER.
- B. Arrange deliveries of products in accord with progress schedules and in sufficient time to facilitate inspection prior to installation.
- C. Coordinate deliveries to avoid conflict with WORK and conditions at site and to accommodate the following:
 - 1. Work of other contractors, or RESIDENT ENGINEER.
 - 2. Limitations of storage space.
 - 3. Availability of equipment and personnel for handling products.

SECTION 01600 - MATERIALS AND EQUIPMENT

4. OWNER's use of premises.
- D. Products shall not be shipped from the manufacturer's or fabricator's facility or delivered to project site until related Shop Drawings, data sheets, shop or factory test reports and records, have been returned without objection by the RESIDENT ENGINEER.
- E. Shipments of materials to CONTRACTOR or subcontractors shall be delivered to the site only during regular working hours. Shipments shall be addressed and consigned to the proper party giving name of project, street number and city. Shipments shall not be delivered to RESIDENT ENGINEER.
- F. Products shall not be delivered to the site until required storage facilities have been provided and are ready to receive products for storage.
- G. Products shall be delivered to site in manufacturer's original, unopened, labeled containers. Keep RESIDENT ENGINEER informed of delivery of all equipment to be incorporated in the Work.
- H. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.
- I. Immediately on delivery, inspect shipment to ensure:
 1. Product complies with requirements of Contract Documents and reviewed submittals.
 2. Quantities are correct.
 3. Containers and packages are intact, and labels are legible.
 4. Products are properly protected and undamaged.
- J. Package or crate products to protect from damage during shipping, handling, and storage.
 1. Mark or tag outside of packing to indicate contents by name and equipment number, special precautions for handling, and recommended requirements for storage.
 2. Protect machined and unpainted parts subject to damage by the elements.
 3. Transport and handle products in accordance with manufacturer's written instructions.
 4. Inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- K. Subsection 1.5 Product Handling below applies to this Subsection, Product Delivery.

SECTION 01600 - MATERIALS AND EQUIPMENT

1.5 PRODUCT HANDLING

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

1.6 PRODUCT STORAGE

- A. Store and protect materials in accordance with manufacturer's recommendations and requirements of the CONTRACT DOCUMENTS.
- B. Manufacturer's product containers shall not be opened until time of installation.
- C. CONTRACTOR shall make all arrangements and provisions necessary for the storage of materials and equipment. All excavated materials, construction equipment, and materials and equipment to be incorporated into the WORK shall be placed so as not to injure any part of the WORK or existing facilities, and so that free access can be maintained at all times to all parts of the Work and to all public utility installations in the vicinity of the WORK. Materials and equipment shall be kept neatly and compactly stored in locations that will cause a minimum of inconvenience to the OWNER, other contractors, public travel, adjoining owners, tenants and occupants. Arrange storage in a manner to provide easy access for inspection.
- D. Areas available on the construction site for storage of materials and equipment shall be within the project site or at other sites approved by the RESIDENT ENGINEER. Products shall not be stored inside structures being constructed.
- E. Materials and equipment shall be stored to facilitate inspection and to ensure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture.

SECTION 01600 - MATERIALS AND EQUIPMENT

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

PART 2 -- PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Provide new industrial quality products for the WORK, unless used or reuse of existing is specifically authorized in the CONTRACT DOCUMENTS.

SECTION 01600 - MATERIALS AND EQUIPMENT

- B. Provide standard catalogue products of manufacturers regularly engaged in the manufacture of the products unless specifically authorized otherwise.
 - 1. Provide products that comply with specified requirements and that will function properly in their expected environment and under expected service conditions.
 - 2. Where two or more units of the same product class are provided, provide products from the same manufacturer that are interchangeable.
 - 3. Factory assemble equipment when practical.
 - 4. For equipment shipped unassembled, provide with assembly plans and written instructions. Match-mark or tag separate parts and assemblies to facilitate field assembly.
 - 5. Install products accordance with requirements of CONTRACT DOCUMENTS and approved manufacturer's recommendations
- C. CONTRACTOR shall make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the WORK.
- D. Product fabrication, manufacture, or purchase shall not begin until related Shop Drawings are returned without objection by the RESIDENT ENGINEER.

PART 3 -- EXECUTION

3.1 SYSTEMS DEMONSTRATION

- A. Prior to final inspection, demonstrate satisfactory operation of each system to RESIDENT ENGINEER.

3.2 INSTRUCTION OF OWNER'S PERSONNEL

- A. Instruct OWNER's personnel in operation, adjustment, and maintenance of equipment and systems, using operation and maintenance data as the basis of instruction in accordance with the requirements of Section 01660 - Facility Start-Up and Operator Training and Section 01730 - Operation and Maintenance Information.

**** END OF SECTION ****

SECTION 01660 – FACILITY START-UP AND OPERATOR TRAINING

PART 1 -GENERAL

1.1 START-UP SERVICES

A. General

1. Start-up is defined as the initial operation of the plant, utilizing potable water.
2. The CONTRACTOR shall be required to start up the facility, under direction of the RESIDENT ENGINEER, operate it, and pass a 14-day test prior to Substantial Completion. All equipment must properly run continuously 24 hours per day for the test period at rates indicated by the RESIDENT ENGINEER. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the malfunction.
3. The purpose of this 14 -day test is to:
 - a. Provide the environment by which the RESIDENT ENGINEER 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 RESIDENT ENGINEER, prior to Final Acceptance.

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 RESIDENT ENGINEER for start-up of equipment and systems.
3. Review procedures for facility start-up.
4. Review outstanding punch list items with the RESIDENT ENGINEER 15 days prior to the scheduled start-up; and complete, correct, or resolve at the option of the RESIDENT ENGINEER, any items which impact or interfere with the facility start-up.
5. Attend meetings related to the review of start-up plan(s).

SECTION 01660 – FACILITY START-UP AND OPERATOR TRAINING

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 RESIDENT ENGINEER a list of 24 hour, "on call" representative supervisory persons who will monitor the facility start-up, and serve as a liaison for the RESIDENT ENGINEER .
 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 RESIDENT ENGINEER. 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 RESIDENT ENGINEER will coordinate the facility start-up period and 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. In addition to the Vendor Training required in Section 01300 - Submittals, the CONTRACTOR shall be required to train Water

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Department Operations staff in the operation and maintenance of project facilities during the 14-day start-up testing period.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01680 – PHYSICAL CHECKOUT, SHOP, FIELD, AND FUNCTIONAL TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The physical inspection and testing requirements in this Section are in addition to those requirements defined in Divisions 02 through 16 of the Technical Specifications. These activities shall be performed prior to substantial completion.
- B. Provide the following checkout and testing activities:
 - 1. Shop Testing of equipment as specified in Divisions 02 through 16, and as specified herein.
 - 2. Physical checkout and inspection of equipment and materials to verify conformance of the installed equipment and materials to the CONTRACT DOCUMENTS.
 - 3. Field Testing of equipment as specified in Divisions 02 through 16, and as specified herein.
 - 4. System Loop Checks as specified in Divisions 02 through 16, and as specified herein.
 - 5. Functional Testing of equipment as specified in Divisions 02 through 16, and as specified herein.
- C. Provide a Checkout Plan covering the entire checkout and testing process in conformance with the CONTRACT DOCUMENTS, and as specified herein.

1.2 DEFINITIONS

- A. Shop Testing is defined as testing that is done by the Supplier either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the products meet the requirements of the pertinent technical specification(s). The administrative procedures for shop testing are specified in subsection 1.5 of this Section, while the technical requirements are included in the pertinent technical specification(s). The minimum acceptable test criteria are specified in subsection 1.4 of this Section.
- B. Physical Checkout is defined as the process of physically inspecting products after they have been installed to determine if the products have been properly and completely installed, comply with the approved shop drawings and are ready for Field and/or Functional Testing. The requirements for Physical Checkout (if applicable) are contained in the pertinent technical specifications and in subsection 1.8 of this Section.

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- C. Field Testing is defined as testing that is performed by the CONTRACTOR, and/or Subcontractors, with Supplier assistance, on products after they have been installed, and after the performance of physical checkout, for the purpose of proving that the tested products meet the requirements of the pertinent technical specifications. Field testing is required regardless of whether or not shop testing was performed on the same piece of equipment or material. The administrative requirements for field testing are specified in subsection 1.9 of this Section, while the technical requirements are contained in the pertinent technical specification(s). The minimum acceptable test criteria are specified in subsection 1.4 of this Section.
- D. System Loop Checks - (Applies to equipment or systems controlled by the Distributed Control System) are defined as tests performed jointly by the CONTRACTOR and the Control Systems Provider providing control systems (COMNET), to verify the control wiring (both hardwired and datalink) between the Distributed Control System and instruments or equipment which it monitors or controls throughout the plant. Loop checks are to be performed to insure the Distributed Control System can properly control or monitor each instrument or piece of equipment and that the systems are ready for functional testing. The requirements and procedures for Loop Checks are contained in the pertinent specifications and subsection 1.10 of this section.

Loop Checks are defined as tests performed to verify the control wiring (both hardwired and datalink) between local control panels (LCPs) and/or the distributed control system (DCS) and instruments or equipment which they control. The CONTRACTOR performs loop checks from local control panels to all instruments or equipment which they control. Additionally the CONTRACTOR shall perform loop checks jointly with the Control Systems Provider (CSP) CONTRACTOR, for instruments or equipment controlled by the distributed control system. The test verifies proper operational control or monitoring of the instrument or equipment. Loop checks are to be performed to insure the LCP and/or the DCS can properly control or monitor each instrument or piece of equipment and that the systems are ready for functional testing. The requirements and procedures for System Loop Checks are contained in the pertinent specifications and subsection 1.10 of this section.

- E. Functional Testing is defined as testing performed by the CONTRACTOR on a "system" normally comprised of two or more pieces of equipment, after the equipment has been installed, and after Physical Checkout and Field Testing have been completed, for the purpose of proving that the system meets requirements as specified and as indicated. The administrative requirements for Functional Testing are specified in subsection 1.11 of this Section, while the technical requirements are specified in the technical specifications.
- F. The Supplier's Representative or Manufacturer's Representative is defined as a person, or persons provided by the Supplier or Manufacturer, who is qualified by having the training and experience, to provide technical and/or process-

SECTION 01680 – PHYSICAL CHECKOUT, SHOP, FIELD, AND FUNCTIONAL TESTING

related advice, and/or assistance, relating to the installation or utilization of the products provided by that same Supplier. The Supplier's Representative or Manufacturer's Representative shall be a Professional Engineer registered in the State of California in the discipline most appropriate for the product provided or approved by the RESIDENT ENGINEER.

- G. The Testing, Checkout, and Start-Up Coordinator is defined as the person provided by the CONTRACTOR to coordinate and oversee the total spectrum of testing and inspection activities required by the CONTRACT DOCUMENTS. The Testing and Checkout and Start-Up Coordinator shall be a Professional Engineer registered in the State of California in the discipline most appropriate for the equipment to be tested and checked out or approved by the RESIDENT ENGINEER.

1.3 ROLES AND RESPONSIBILITIES

- A. The CONTRACTOR shall provide all outside services, materials, labor, supplies, test equipment and other items necessary to perform the testing specified herein and interim connections. In addition the CONTRACTOR shall arrange for and provide the participation or assistance of survey crews, engineers, quality control technicians, Suppliers' and/or Manufacturer's representative(s), and required utility, regulator, or governmental agency representatives.
- B. The CONTRACTOR shall provide the services of the Supplier's and/or Manufacturer's representative(s) as follows:
- C. The Supplier's and/or Manufacturer's representative's activities required by this Section are in addition to the requirements for vendor training and other services specified elsewhere in the CONTRACT DOCUMENTS. Timing for the performance of these services shall be defined in the Checkout Plan, specified herein.
- D. The RESIDENT ENGINEER may review and comment on the CONTRACTOR's deliverables, participate in the physical inspection activities, witness the shop and field testing, witness loop checks, witness functional testing, and provide verification of conformance to the specifications.
- E. The CONTRACTOR shall be responsible for incorporating these procedures into the CPM schedule. No additional time or compensation will be approved relating to delays associated with these requirements.

1.4 MINIMUM SHOP AND FIELD TESTING REQUIREMENTS

In addition to procedures referenced for shop and field testing contained in a technical specification, the following shall be required. Should these requirements conflict with the Supplier's recommendations in any way; the more stringent requirements will prevail.

SECTION 01680 – PHYSICAL CHECKOUT, SHOP, FIELD, AND FUNCTIONAL TESTING

- A. Measurement of wearing ring clearances for all pumps requiring assembly, so equipped:
 - 1. Provide a minimum of two measurements of clearances taken opposed to each other by 90°.
 - 2. All measured clearances shall be within Supplier's specifications for new installations. Replace and recheck rings found to be out of round or out of specified tolerance.

- B. Measurement of Impeller Bore for all pumps requiring assembly:
 - 1. Provide a minimum of two measurements of the Impeller Bore opposed to each other by 90°.
 - 2. All measured clearances shall be within Supplier's specifications for new installations. Replace and recheck impellers found to be out of round or out of specified tolerance.

- C. Measurement of shaft run out for all rotating equipment requiring assembly:
 - 1. Remove bearings from the shaft. Support shaft on pedestal rollers or in a lathe.
 - 2. Remove bearings from the shaft. Support shaft on pedestal rollers or in a lathe.
 - 3. Take a minimum of two measurements of each shoulder, opposed to each other by 90°.
 - 4. All measurements and clearances shall be within Supplier's specifications for new installations. Replace and recheck shafts found to be out of round or out of specified tolerance.

- D. Vibration Measurement:
 - 1. Conduct a torsional and vibration analysis of equipment in accordance with the requirements of Section 11000 and the applicable equipment specifications.

- E. Gear Drives and Reducers:
 - 1. Check gears for lash at no less than three points around the gear.
 - 2. Rotate gears a full 360° while checking alignment.

- F. Coupling/Shaft Alignment:

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1. Perform all final alignments and checks with a dial indicator or a laser device. Feeler gauges and straight edges are not acceptable.
 2. Eliminate soft foot conditions prior to aligning.
 3. When checking for final soft foot, any displacement in excess of 0.002" must be corrected.
 4. When checking for pipe strain, any displacement in excess of 0.002" must be corrected.
 5. Alignments will not be regarded as final until the grout is set and all piping has been attached. Demonstrate that alignment is not changed by attachment of piping.
 6. Shim the driving element, never the driven element.
 7. Take bracket sag corrections into account when using a dial indicator. Bracket sag shall be determined on a rigid pipe.
 8. Mount a dial indicator to the driven element so that it can be rotated. Rotate both elements while aligning.
 9. When aligning three coupled elements, align gear reduction elements with the driven element first, then align the driver to the gear reduction element.
 10. Check all four alignments; i.e., angular alignment in the vertical and horizontal planes, and parallel alignment in the vertical and horizontal planes.
 11. The minimum acceptable alignment accuracy for flexible couplings is ± 0.005 ", or the Supplier's specifications, whichever is more stringent.
 12. The dial indicator must be perpendicular to the alignment surface.
 13. Number hold down nuts prior to tightening. Loosen in reverse order. Tighten in ascending order.
 14. Use only clean, deburred shims. Clean the machine base and feet from rust or burrs prior to alignment.
- G. Measurement of Noise (dB)
1. Eliminate noise sources generated by adjacent construction activity prior to testing.
 2. Establish a background noise level prior to testing.
 3. Perform noise level testing whenever a maximum noise level is indicated. A noise test will also be required for any equipment likely to exceed OSHA standards for one hour exposure without hearing protection.

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H. Hydrostatic Testing:

1. AWWA C600 standards latest edition are the minimum acceptable standards for all hydrostatic testing.
2. Visually inspect all welds prior to testing, for cracks, undercut on surface greater than 1/32" deep, lack of fusion on surface, reinforcement greater than specified in Table 127.4.2 located in ANSI B31.1 Power Piping, and incomplete penetration (when accessible). Repair or rework as directed by the RESIDENT ENGINEER.
3. At no time during hydrostatic testing shall any part of the piping system be subjected to a stress greater than 90% of its yield strength at test temperature.
4. After at least 10 minutes of full hydrostatic test pressures, make an examination for leakage of all joints, connections, and all regions of high stress, such as around openings and thickness transition sections.
5. Unless otherwise specified, the minimum required hydrostatic test pressure shall be 1.5 times the design pressure as specified and as indicated.
6. Unless otherwise specified, the minimum pressure holding time shall be 10 minutes plus the time required to inspect for leakage.
7. Maximum pressure shall not exceed the maximum rated pressure for any component in the system being tested.

I. Electrical Equipment

1. The testing standards for electrical components are those contained in the pertinent technical specification(s).
2. Functional and field testing shall follow the Physical Checkout and are contained in the pertinent technical specification(s).

1.5 SHOP TESTING

- A. When required by the Technical Specifications, perform shop testing prior to delivery of the equipment or material. Unless otherwise noted, provide 45 days written notice indicating the time and place of testing. The CONTRACTOR shall submit the following for approval thirty days prior to this notice:
1. Description of the equipment and the applicable specification sections
 2. Description of the test: Specifically outlining how tests will conform to the requirements in the Technical Specifications.

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3. Testing Devices That Will Be Used in the Tests: Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.
 4. Personnel Used to Perform the Tests: Resumes, qualifications, and experience shall be submitted. Personnel performing tests shall be Professional Engineers registered in the discipline most appropriate for the testing that will be performed.
 5. Schedule for testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.
 6. Test forms: Submit all forms used to record and report on Shop Test data, for approval, prior to the test. No testing shall be conducted until these forms are approved. Forms shall provide the following information: description of test, equipment used, personnel present, equipment specification numbers, and measurements made. Forms shall have a place for signature by the person responsible for conducting the test, and an officer of the company verifying that the tests performed are true, accurate, have met the required criteria, and that the equipment will operate as indicated and as specified.
- B. Shop test procedures will be reviewed and returned by the RESIDENT ENGINEER within 15 days of receipt. Incorporate minor comments related to the procedures, equipment, or personnel prior to testing. Major comments by the RESIDENT ENGINEER will require a resubmission of the shop test procedure and proposed test date. The CONTRACTOR will be notified, in writing by the RESIDENT ENGINEER, if a formal resubmission is required with the transmittal of the review comments.
- C. Travel, lodging, rental car, meals, and other travel-related expenses for the RESIDENT ENGINEER and other OWNER personnel, prior to, during, and after the testing, will be paid for by the CONTRACTOR.
- D. Submit 6 (six) copies of the following within seven (7) days after completion of the tests for approval:
1. Completed test forms, for each device tested, on forms as approved prior to the test.
 2. Completed certification, the content of which was approved prior to the tests.
 3. A written summary of test; a report of the results and a summary of the entire procedure.
 4. A schedule for retesting, if necessary. The CONTRACTOR shall perform any retesting required to fulfill the intent of the Technical Specification test requirements at no additional cost to the OWNER. Additional travel required by the RESIDENT ENGINEER and other OWNER personnel to

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witness retesting shall be paid by the CONTRACTOR. Reimbursement for travel expenses required for retesting will be applied as a debit against the CONTRACTOR'S subsequent Application for Payment. Allowable travel cost will be in accordance with the travel expenses reimbursements permitted by City regulations.

1.6 WITNESSING OF TESTS

- A. Unless otherwise noted, provide a minimum of 45 days written notice to the RESIDENT ENGINEER so that the RESIDENT ENGINEER and other OWNER representatives, may have the opportunity to witness the Shop tests, Field tests, Loop checks, and Functional tests. The RESIDENT ENGINEER and other OWNER representatives may witness the performance of any or all tests, at their option. The RESIDENT ENGINEER's or OWNER's representatives witnessing of tests does not relieve the CONTRACTOR of its obligation to comply with the requirements of the CONTRACT DOCUMENTS.

1.7 CHECKOUT PLAN

A. The CONTRACTOR shall submit a Checkout Plan based upon the requirements defined herein, and the Technical Specifications to the RESIDENT ENGINEER. Six (6) copies and 1 (one) copy on electronic media (MS Word) of the preliminary Checkout Plan shall be submitted for review at least 21 calendar days prior to the proposed date of the first test. The plan shall define:

1. The equipment and applicable specification section(s) for the equipment
2. The logical and systematic performance of physical inspections, shop tests, field tests, loop checks, and functional tests including:
 - a. A chronological schedule of all testing, checking, and inspection activities.
 - b. A checklist of all inspection, checking, and testing activities broken down by location, discipline, system, and device or item.
 - c. All blank forms proposed by the CONTRACTOR for verification or recording for all testing.
 - d. An index which cross references the forms to their intended application(s).
 - e. A list of all shop tests, and supplier certifications, including those required by the applicable technical specifications. Provisions shall also be included for re-testing, in the event it is required.
3. Participants in the testing.
4. Special test equipment.
5. Sources of the test media (water, power, air.)

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6. The proposed method of delivery of the media to the equipment to be tested.
 7. Temporary or Interim connections for the sequencing of multiple units.
 8. Ultimate proper disposal of the test media.
- B. The plan will be reviewed by the RESIDENT ENGINEER, modified or revised within 90 days as necessary by the CONTRACTOR, then approved by the RESIDENT ENGINEER. The CONTRACTOR shall continue to update the Checkout Plan, working in conjunction with the RESIDENT ENGINEER prior to the start of the scheduled equipment checkout and functional testing activities. Each specific element of the plan must receive written approval by the RESIDENT ENGINEER at least two weeks prior to the actual commencement of testing.
- C. The CONTRACTOR shall designate, in the Checkout Plan, a coordinator for Testing, Checkout, and Start-Up to coordinate and manage the activities defined in the checkout plan, as approved by the RESIDENT ENGINEER.

1.8 PHYSICAL CHECKOUT AND INSPECTIONS

- A. Physical Checkout and inspections provide verification of conformance to the requirements of the Technical Specifications and Contract Drawings for physical presence; dimensions; and location, for proper materials, parts, and items; and for integrity of materials, equipment and systems to determine their condition and readiness for field and/or functional testing. Inspection includes the following elements, as applicable
1. Exterior areas for backfill, grading, surfacing, drainage, landscaping, roadways, fencing, gates, and signage.
 2. Building structural integrity, masonry, architectural, mechanical systems, electrical/lighting, communications, and HVAC systems.
 3. Concrete structures for structural integrity, finish, tolerance, durability, appearance, embedded and inserted items, painting and surface applications.
 4. Steel structures for member alignment, connection bolts torque, connection welds integrity, painting, fire proofing and surface applications.
 5. Mechanical systems and items for installation, alignment and securing, adjustments of packing and seals, lubrication, drive connection and alignment, motor rotation, belt/chain tension, painting or surface applications, and tagging for identification.
 6. Piping systems for material, size, components, direction, alignment of joints and bolting/welding, valves, packing and seals, screens, filters and strainers, painting, identification labeling and color coding, hangers, anchors, supports, and expansion provisions.

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7. Electrical and control/instrumentation systems for conduit and tray installation, wire/cable material and size, circuit identification, terminal installation and identification, major switches, circuit breakers and components, and labeling for system identification.
 8. Communication systems including telephone, fire/smoke alarm, security, page/party, and closed circuit TV; similar to electrical above.
 9. Computer systems by station, function, and network interface.
- B. Inspection will verify that tanks, pipes, conduits, vessels, equipment, systems, buildings, areas and other items provided under the Contract are clean and free from debris or materials which may interfere with subsequent testing requirements or routine operations. Correct unsatisfactory conditions prior to testing or acceptance.
- C. Upon completion of the inspection, submit to the RESIDENT ENGINEER six (6) copies of each completed inspection form, signed by an authorized representative of the CONTRACTOR who participated in the inspection. The RESIDENT ENGINEER will review and approve the contents of the forms. Should a reinspection be required, it shall be performed at no additional cost to the OWNER.

1.9 FIELD TESTING OF EQUIPMENT

- A. CONTRACTOR Personnel: The CONTRACTOR shall provide the services of an experienced and authorized Supplier's or Manufacturer's representative for each item of equipment indicated in the equipment schedules (excluding manually-operated valves smaller than 24-inches in size, injectors, tanks, batch-type disc meters, and rotometers, and any other minor items of equipment specifically exempted in writing by the RESIDENT ENGINEER and DESIGNER), who shall visit the site of the WORK and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the CONTRACTOR shall arrange to have the Supplier's or Manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the RESIDENT ENGINEER. The CONTRACTOR shall notify the RESIDENT ENGINEER of the visit of the Supplier's or Manufacturer's representative at least 48 hours in advance of arrival at the work site.
- B. CONTRACTOR's Report: The CONTRACTOR shall deliver to the RESIDENT ENGINEER a written report prepared by the Supplier's or Manufacturer's representative, addressed to the OWNER, certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily under full-load conditions. The Supplier's or Manufacturer's representative shall also provide written authorization that the equipment can be operated. This report shall be submitted within 7 days of the Supplier's or Manufacturer's representative visit to the site.
- C. Scheduling Tests: The CONTRACTOR shall be responsible for scheduling all field testing. The CONTRACTOR is advised that the RESIDENT ENGINEER and the OWNER's operating personnel will witness field testing and that the

SECTION 01680 – PHYSICAL CHECKOUT, SHOP, FIELD, AND FUNCTIONAL TESTING

Supplier's or Manufacturer's representative shall be required to instruct the OWNER's operating personnel in the correct operation and maintenance procedures. Such instruction shall be scheduled at a time arranged with the RESIDENT ENGINEER at least 2 weeks in advance, and shall be provided while the equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems in the plant. One hundred and twenty (120) days prior to scheduling any field testing, the CONTRACTOR shall have previously received approval of the Owner's Manual. No field testing will be permitted if this requirement is not met. Any associated delays to the completion of the contract resulting from delayed testing due to incomplete or unapproved OWNER's manuals will be the responsibility of the CONTRACTOR.

- D. Test Support: The CONTRACTOR shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, temporary and interim connections, and services required for conducting the tests and shall properly dispose of all material, media, and lubricants upon completion of the test.
- E. Notice Requirement: Field testing shall be in addition to, and not in lieu of, shop testing. Field testing will be performed as a part of the overall physical and functional testing process defined herein and in accordance with the approved Checkout Plan. However, as a minimum the following specific instructions shall also apply. The CONTRACTOR shall provide 60 (sixty) calendar days written notice indicating the date and time for testing each piece of equipment, or a series of equipment pieces.
 - 1. All equipment installed by the CONTRACTOR shall undergo an operational check by the CONTRACTOR to verify that the equipment is functioning (electrically, mechanically and structurally) as it has been designed.
 - 2. Each device shall be operated through its full range of motion and each instrument shall be checked against its full span.
 - 3. At a minimum, this check shall include turning the equipment on and running it through one full cycle. This cycle shall include all operating possibilities. Signals or interlocks from other pieces of equipment may be simulated upon prior approval of the RESIDENT ENGINEER.
- F. Review of Procedures: Field test procedures will be reviewed and returned by the RESIDENT ENGINEER within 30 (thirty) days of receipt. Incorporate minor comments to the procedures, equipment, or personnel prior to testing. Major comments by the RESIDENT ENGINEER will require a resubmission of the field test procedure and proposed test date. The CONTRACTOR will be notified, in writing, by the RESIDENT ENGINEER if a formal resubmission is required with the transmittal of the review comments.
- G. Additional Notice Requirements: Provide 7 (seven) days written notice to the RESIDENT ENGINEER prior to the actual start of any testing. This will include a statement by the CONTRACTOR that the equipment and facilities to be tested have been thoroughly inspected and cleaned of construction debris or other

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extraneous materials and all lubrication, materials, and preparations are completed.

- H. Test Report Requirements: At conclusion of the test the CONTRACTOR will deliver draft test report data, and then submit, within 7 (seven) days after completion of the tests, 6 (six) copies of the following to the RESIDENT ENGINEER for approval:
1. Completed test forms, for each device tested, on forms provided by the CONTRACTOR prior to the tests.
 2. Completed certification documentation, the content of which was approved prior to the tests.
 3. A written summary of the test; a report of the results and a summary of the entire procedure.
 4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the OWNER.

1.10 SYSTEM LOOP CHECKS

- A. Loop checks are performed jointly by the CONTRACTOR and the Control Systems Provider after field testing. The CONTRACTOR will have primary responsibility and will provide personnel to insure that the installed equipment and/or instruments are properly installed and operating during loop checks. The Control Systems Provider will provide personnel to operate the Distributed Control System (DCS). The CONTRACTOR will provide communication equipment as required for the Control Systems Provider and RESIDENT ENGINEER personnel to insure coordinated communication between the field and the Control Room.
- B. The CONTRACTOR will provide 30 (thirty) days written notice indicating the date and time when loop checks will start. Submit with this notice a loop check package which includes the following to the RESIDENT ENGINEER for approval:
1. Testing devices that will be used in the tests: Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.
 2. Schedule for Testing: Schedule shall include frequency of measurement, personnel present, and contingency plans for equipment and/or system failure.
 3. Test forms: Provide test forms for recording and reporting on the test data.
 4. Provide material and equipment required for the test.
 5. Utility requirements: Utilities will be supplied by the CONTRACTOR for loop checks, as required.

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6. Operational requirements: Include precautions which will be taking to protect equipment and personnel during testing.
- C. The RESIDENT ENGINEER may witness the performance of these tests, at their option.
- D. Approval of the loop check package will be made within two weeks of the test date. Incorporate minor comments on the procedures and equipment prior to testing. Major comments by the RESIDENT ENGINEER will require a resubmission of the loop check package and test date.
- E. The CONTRACTOR shall provide seven days written notice to the RESIDENT ENGINEER prior to the actual start of any testing.
- F. The CONTRACTOR shall submit within one week after completion of the tests, the following to the RESIDENT ENGINEER for approval:
 1. Completed test forms, for each loop tested on forms provided by the CONTRACTOR and approved prior to the test.
 2. Written summary of testing, reporting on the results and summarizing the entire procedure.
 3. A schedule for retesting, if necessary, including changes to procedures, testing devices, or personnel. Any retesting required to fulfill the intent of these requirements, due to negligence, poor workmanship, or products that fail to meet the Contract requirements, shall be at no additional cost to the OWNER.

1.11 FUNCTIONAL TESTING

- A. When listed in the APPENDIX of this particular Section, specific functional tests shall be performed by the CONTRACTOR who supplied the equipment being tested in addition to the requirement for shop, field, and other tests called for in the Technical Specifications. If more than one CONTRACTOR supplied the equipment being tested, each CONTRACTOR will provide a representative for the functional test team, and the team leader will be the representative from the CONTRACTOR with the major piece of equipment being tested. If no clear distinction exists under this criteria, then the CONTRACTOR with the largest dollar value of equipment incorporated into the system being tested shall be the team leader. Functional tests will be performed with fluid or gaseous substances that are generally non-septic, non-corrosive, non-toxic, and non-inflammable.
- B. The CONTRACTOR shall provide 45 days written notice in accordance with Section 1.6, indicating the date and time during which the specified functional test is proposed. Submit with this notice a contract specific functional test plan which follows the generic functional test plan included in the contract, and which includes the following to the RESIDENT ENGINEER for approval:
 1. Description of the system's equipment, piping, valves, instruments and other components, and the applicable specification sections.

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2. Test procedures to be provided by RESIDENT ENGINEER.
 3. Testing devices that will be used in the tests: Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.
 4. Personnel used to perform the tests: Submit resumes and qualifications. As a minimum, personnel must have three (3) years experience with the operation of the equipment and/or system to be tested and have participated in five similar tests during this period of experience.
 5. Schedule for Testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or system test failure.
 6. Test forms: Provide test forms for recording and reporting on the test data.
 7. Material and equipment required for the test.
 8. Utility requirements: Utility requirements will be identified and supplied by the CONTRACTOR for functional testing purposes. Provide labor for the reuse of the test water.
 9. Operational requirements: Include valve positions, set-ups, and gate positions that are required to run the tests in the written request so that the CM can anticipate and plan for the testing. Provide all temporary piping, connections or other temporary requirements related to performance of the functional tests.
 10. The CONTRACTOR shall develop a Function Test Schedule which allows no less than 120 days to complete the Functional Test Program.
- C. The CONTRACTOR will be obligated for installation and cost associated and cost associated with all temporary materials and systems required to facilitate functional testing.
- D. The RESIDENT ENGINEER will direct specific actions when conflicts surface and will witness the performance of these tests.
- E. Approval of the functional test package by the RESIDENT ENGINEER will be made within two weeks of the test date. Incorporate minor comments on the procedures, equipment, and personnel prior to testing. Major comments by the RESIDENT ENGINEER will require a resubmission of the functional test package and test date.
- F. Provide seven days written notice to the RESIDENT ENGINEER prior to the actual start of any testing. This will include a statement by the CONTRACTOR that the equipment and facilities to be tested have been thoroughly inspected

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and cleaned of construction debris or other extraneous materials and all lubrication, materials, and preparations are completed.

- G. Submit within 7 (seven) days after completion of the tests, 6 (six) copies of the following to the RESIDENT ENGINEER for approval:
 - 1. Completed test forms, for each device, or system tested, on forms approved prior to the test.
 - 2. Completed certification, the content of which was approved prior to the tests.
 - 3. A written summary of the test; a report of the results and a summary of the entire procedure.
 - 4. A schedule for retesting, if necessary, including changes to procedures, testing devices, or personnel. Any retesting required for failures due to negligence, poor workmanship, or due to using products that do not meet the Contract requirements shall be at no additional cost to the OWNER.

1.12 CORRECTIONS TO THE WORK

- A. Correct any items of work falling to meet the specified requirements, at no additional cost to the OWNER. Correct the nonconforming items by re-work, modification, or replacement, at the option of the RESIDENT ENGINEER. This includes the provision of all required labor, materials, and requirements for retesting as specified herein, to verify that the items conform to CONTRACT DOCUMENTS.

1.13 SAFETY

- A. Conduct all specified test procedures in compliance with all applicable safety standards and regulations.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. CONTRACTOR shall provide operation and maintenance data and information in the form of instructional material for use by the OWNER's personnel for:
1. All equipment and systems
 2. All valves, gates and related accessories
 3. All instruments and control devices
 4. All electrical gear
- B. Training or start-up on any system or piece of equipment shall not be allowed until the CONTRACTOR's submittal of Operation and Maintenance Information has been incorporated into project O & M Manuals by the Design Consultant, the CONTRACTOR's Lesson Training Plans are approved by the RESIDENT ENGINEER, and the approved Operation and Maintenance Manuals have been turned over to the RESIDENT ENGINEER.
- C. Definitions:
1. Operation and Maintenance Information:
 - a. The term "operation and maintenance information" includes all product-related information and documents which are required for preparation of the plant operation and maintenance manual. It also includes all data which shall accompany said manual as directed by current regulations of any participating government agency.
 - b. Required operation and maintenance data include, but are not limited to, the following:
 - (1) Equipment Summary. The CONTRACTOR completes an Equipment Record Form provided by the RESIDENT ENGINEER (See Form below(2 pages), within this section Of 01730), for each item of mechanical, electrical and instrumentation equipment installed at the facility.
 - (2) Mechanical Operational Procedures. The CONTRACTOR describes mechanical operational procedures for all installed equipment, as appropriate, including installation instructions, adjustment, startup, operation, load changes,

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

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.

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

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		D	W	M	O	S	A	H
Preventive Maintenance Requirements		D	W	M	O	S	A	H
Recommended Spare Parts			Electrical Name Plate Data					
Part	Part Name	Quan	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		

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

			Misc

Form No. _____

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SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

Equipment Record Form (continued)

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

Form No. _____

Page 2 of 2

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

D. Submittals:

1. General: Submit operations and maintenance information to the RESIDENT ENGINEER within ninety (90) days after approval of Shop Drawings, unless noted otherwise.
2. Number of Copies: ten (10) of each item.
3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:
 - a. Date of submittal
 - b. Contract title and number
 - c. CONTRACTOR's name and address
 - d. A list of the attachments and the Specification Sections to which they relate
 - e. Reference to or explanation of related submittals already made or to be made at a future date
4. Format Requirements:
 - a. Use 8-1/2-inch by 11-inch paper of high rag content and quality. Larger drawings or illustrations are acceptable if neatly folded to the specified size in a manner which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab. Or provide fly-leaf for each product.
 - b. All text must be legible, typewritten or machine printed originals or high quality copies of same.
 - c. Each page shall have a binding margin of approximately 1-1/2 inches and be punched for placement into a three-ring, loose-leaf binder. Provide binders. Identify each binder with the following:
 - (1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS"
 - (2) Title of Project.
 - (3) Identity of building or structure as applicable.
 - (4) Identity of general subject matter covered.

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

- d. Use dividers and indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
- e. Provide a table of contents for each binder.
- f. Identify products by their functional names in the table of contents and at least once in each chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.
- g. Indicate all components of the equipment on catalog pages by highlighting or some other clearly definable medium for ease of identification.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 01680 Physical Checkout, Shop, Field, and Functional Testing
- 3. Section 02630 Ductile Iron Pipe
- 4. Section 02645 PVC Pressure Pipe (4 in. and Smaller)
- 5. Section 02646 PVC Pressure Pipe (Larger than 4-inch)
- 6. Section 02650 Steel Pipe, Lined and Coated
- 7. Section 02653 Fabricated Steel Pipe Specials
- 8. Section 02810 Landscape Irrigation Systems
- 9. Section 02900 Landscape Planting
- 10. Section 07721 Rooftop Fall Protection
- 11. Section 07810 Skylights
- 12. Section 10200 Louvers and Vents
- 13. Section 10520 Fire Extinguishers
- 14. Section 11209 Submersible Sump Pumps
- 15. Section 11214 Vertical Turbine Pumps
- 16. Section 11220 Reservoir Sample Pump/Mixer
- 17. Section 13300 Instrumentation and Control
- 18. Section 13314 In-Line Flow Measuring Systems
- 19. Section 15000 Piping Components
- 20. Section 16200 Emergency Generator
- 21. Section 16290 Power Monitors
- 22. Section 16500 Lighting

SECTION 01730 – OPERATION AND MAINTENANCE INFORMATION

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SECTION 01750 – SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. Ninety (90) days after approval of the Shop Drawings of the equipment specified in the individual Sections, the CONTRACTOR shall furnish spare parts data and maintenance material for equipment. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.
- B. Spare parts and materials required to be supplied in the Contract Documents shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage which may be normally anticipated. They shall be clearly marked and identified as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
- C. During construction, store spare parts in buildings or trailers with floor, roof and closed sides and in accordance with manufacturers' recommendations. Protect from weather, condensation and humidity.
- D. Parts and materials shall be delivered to the RESIDENT ENGINEER upon Substantial Completion of the Work or before start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the RESIDENT ENGINEER. The turnover procedures shall be developed by the RESIDENT ENGINEER.
- 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 RESIDENT ENGINEER.

1.2 RELATED SECTIONS

SECTION 01750 – SPARE PARTS AND MAINTENANCE MATERIALS

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

1. Section 01300 Submittals
2. Section 01600 Materials and Equipment
3. Section 01680 Physical Checkout, Shop, Field, and Functional Testing
4. Section 01730 Operation and Maintenance Information
5. Section 11209 Submersible Sump Pumps
6. Section 11214 Vertical Turbine Pumps
7. Section 11220 Reservoir Sample Pump/Mixer
8. Section 13300 Instrumentation and Control
9. Section 13374 Control Panel Instrumentation
10. Section 16640 Cathodic Protection System

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

SECTION 01750 – SPARE PARTS AND MAINTENANCE MATERIALS

Spare Part Receiver

Project: La Jolla Country Club Reservoir and Pump Station

Specification Section 01750

Manufacturer: _____

Item Description: _____

Cost: _____

Manufacturer Part Number: _____

Supplier: _____

Cross Reference Number: _____

Vendor Information: _____

Vendor Order Part Number: _____

Part to be used on what equipment: _____

Equipment Number: _____

Specification Section: _____

CITY PERSONNEL FILL IN:

Bin Number: _____

Aims Number: _____

Location in Stores: _____

Received By: _____

**** END OF SECTION ****

SECTION 02050 – DEMOLITION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish all materials, equipment and labor necessary to perform and complete demolition of the existing La Jolla Country Club Reservoir and Pump Station as shown on 39252-04-D\\, and described below.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 02150 Sheeting and Shoring
- 3. Section 02200 Earthwork
- 4. Section 02810 Landscape Irrigation Systems
- 5. Section 02900 Landscape Planting

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit a demolition schedule in compliance with Section 01300 - Submittals. The demolition schedule shall provide a complete coordination schedule for demolition work including shut-off and continuation of utility services before the start of the demolition. The schedule shall indicate proposed methods and operations of facility demolition, and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.
- B. Before completion of the Work, the CONTRACTOR shall submit an Affidavit of Legal Disposal attesting to the lawful disposal of all demolished materials.

PART 2 -- PRODUCTS (Not Used)

SECTION 02050 – DEMOLITION

PART 3 -- EXECUTION

3.1 GENERAL

- A. Structures shall be demolished and removed in compliance with the latest edition of SSPWC and the requirements indicated herein.

3.2 POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used for dust suppression in compliance with the latest edition of SSPWC.
- B. Water shall not be used when it creates hazardous or objectionable conditions such as flooding, erosion, sedimentation, or pollution.

3.3 PROTECTION

- A. Safe passage of persons around the area of demolition shall be provided. Operations shall be conducted to prevent injury to people and damage to adjacent buildings, structures, and other facilities in compliance with the latest edition of SSPWC.
- B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement or collapse of structures to be demolished.
- C. Existing landscaping materials, structures, and appurtenances which are not to be demolished shall be protected and maintained as necessary and in accordance with the latest edition of SSPWC.
- D. Unless otherwise indicated, the CONTRACTOR shall protect and maintain all utilities in the proximity of the facilities to be demolished.
- E. The CONTRACTOR shall protect nearby existing equipment from dust caused by demolition activities by covering, drop-curtains and other similar methods.

3.4 STRUCTURE DEMOLITION

- A. Building structures and appurtenances shall be demolished, as shown and required to complete work, in compliance with governing regulations.
- B. Small structures may be removed intact when approved by the utility or authorities having jurisdiction.
- C. Demolition shall proceed in a systematic manner, from top of structure to ground.
- D. Concrete and masonry shall be demolished into small sections. The CONTRACTOR shall use bracing and shoring to prevent collapse of structures.

SECTION 02050 – DEMOLITION

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

3.5 BELOW-GRADE DEMOLITION

- A. Demolition of below grade areas shall be done as noted in the Contract Drawings.
- B. Below-grade areas and voids resulting from demolition of structures shall be completely filled to a minimum compaction of 95%.
- C. All fill and compaction shall be in accordance with Section 02200 - Earthwork.
- D. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.

3.6 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 RESIDENT ENGINEER. Alternate routes shall be provided around closed or obstructed traffic ways.
- B. Site debris, rubbish, and other materials resulting from demolition operations shall be removed and disposed of in compliance with all laws and regulations. Burning of removed materials from demolished structures will not be permitted.

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

SECTION 02050 – DEMOLITION

3.8 CLEANING

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

**** END OF SECTION ****

SECTION 02100 – SITE PREPARATION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish all materials, equipment, and labor necessary to prepare the site including clearing, grubbing and stripping.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 02050 Demolition
 - 2. Section 02200 Earthwork

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 CONTRACTOR SUBMITTALS

- A. Before starting the Work, the CONTRACTOR shall have submitted a Storm Water Pollution Prevention Plan in accordance with the Work requirements.
- B. Before completion of the Work, the CONTRACTOR shall submit an Affidavit of Legal Disposal attesting to the lawful disposal of all materials removed by clearing, grubbing, and stripping.

1.5 DEFINITIONS

- A. The following definitions apply to the Work of this Section:
 - 1. Clearing is defined as cutting trees, removing fences and posts, removing curbs and other improvements to prepare the site for grubbing and stripping.
 - 2. Grubbing is defined as the below grade part of clearing to remove roots, small piping, irrigation systems, etc., to prepare the site for stripping.

SECTION 02100 – SITE PREPARATION

3. Stripping is defined as removing a surface layer of soil and organic material, sod, top-soil, and other unsuitable material as defined in Section 02200 - Earthwork, to a depth that earthwork can proceed.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. Existing Conditions: The site shall be examined and the RESIDENT ENGINEER notified of any conditions which affect the Work of this Section.
- B. Utility Interference: Where existing utilities interfere with the Work of this Section, the RESIDENT ENGINEER shall be notified of interferences, and notifications to the relevant departments and utilities shall be provided in accordance with the latest edition of SSPWC.

3.2 CLEARING, GRUBBING AND STRIPPING

- A. Clearing, grubbing and stripping shall comply with the requirements of SSPWC Subsection 300-1 and the following:
 1. All construction areas shall be cleared of grass and weeds to at least a depth of 6 inches and cleared of structures, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the RESIDENT ENGINEER.
 2. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be totally removed if they are found on the site.
 3. The entire area to be affected by construction shall be stripped of top soil to a depth to be determined by the RESIDENT ENGINEER during construction as successive 6-inch layers are removed to expose the underlying material. If the exposed material contains organic or other material not suitable for use as part of the earthwork in accordance with Section 02200 - Earthwork, additional

SECTION 02100 – SITE PREPARATION

layers of material shall be removed, down to as much as 2.5 feet below the existing ground contours, until all the topsoil is removed. The stripped materials shall be stockpiled and incorporated into landscaped areas or other nonstructural embankments.

4. Unless otherwise indicated, native trees larger than 3 inches in diameter at the base shall not be removed without the RESIDENT ENGINEER 's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way as deemed necessary, shall be arranged with the property owner and be removed and replaced at no increased cost to the OWNER.
5. Except in areas to be excavated, stump holes and other holes resulting from the Work shall be backfilled with suitable material in accordance with Section 02200 - Earthwork.
6. Removal and disposal of all waste materials shall be as indicated in SSPWC Subsection 300-1.3. Unless otherwise indicated, all merchantable timber shall become the property of the CONTRACTOR.
7. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain, shall be removed as directed, but only after the RESIDENT ENGINEER has visited the site and provided written instructions.
8. Project site maintenance shall conform to SSPWC Subsection 7-8.

**** END OF SECTION ****

SECTION 02150 – SHEETING AND SHORING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide protective installation consisting of shores, wales, braces, posts, piling, sheeting, anchorages and fastenings, both temporary and permanent, for accomplishment and protection of work including, but not limited to, the following:
1. Temporary shoring and sheeting for demolition, buried pipelines, reservoir, pump station, vaults, manholes, and other structure excavations.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- | | | |
|----|---------------|-----------------------------------|
| A. | Section 01300 | Submittals |
| B. | Section 02050 | Demolition |
| C. | Section 02200 | Earthwork |
| D. | Section 03300 | Cast-in-Place Concrete |
| E. | Section 03400 | Precast Concrete |
| F. | Section 04232 | Reinforced Concrete Block Masonry |

1.3 SUBMITTALS

- A. Sheet and Shoring Plan. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the RESIDENT ENGINEER and shall be in receipt of the RESIDENT ENGINEER'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. Submit complete calculations of the sheeting system including sheeting size, wales, rakers, anchor system, struts, earth anchors, anchor piles, tie rods or any other components pertinent to the design prior to the start of any work involving sheeting and bracing. The plans shall be prepared by a Civil or Structural Engineer licensed in the State of California
1. As a part of the plan, a note shall be included stating that the registered civil or structural engineer certifies that the plan complies with the CALOSHA Construction Safety Orders. Each copy of the plan shall have an original seal and "wet" signature of a Civil or Structural Engineer registered in the State of California across the seal.
 2. If the CONTRACTOR'S trench protection system includes the use of a shield, the shield design shall be approved by the Division of Industrial Safety. Structural details shall indicate the maximum pressure the shield can safely withstand, the trench configuration and supporting calculations indicating the maximum pressure against the shield. In

SECTION 02150 – SHEETING AND SHORING

portions of the trench near critical existing facilities and areas of dry granular soils, the CONTRACTOR shall use sheeting as required by the RESIDENT ENGINEER in lieu of a shield.

The RESIDENT ENGINEER may have made investigations of subsurface conditions in areas where the Work is to be performed. These investigations are identified in the specifications and the records of such investigations are available at <ftp://ftp.sannet.gov/OUT/ECP/La%20Jolla%20View%20Reservoir/>

The detailed plan showing the design of the shoring, etc., which the CONTRACTOR is required to submit to the RESIDENT ENGINEER in advance of excavation will not be accepted by the RESIDENT ENGINEER if the plan is based on subsurface conditions which are more favorable than those revealed by the investigations made by the RESIDENT ENGINEER, nor will the plan be accepted if it is not based on soils-related design criteria set forth in the report on the aforesaid investigations of the subsurface conditions.

3. The plan shall include surcharge loads for nearby embankments and structures, for spoil banks, and for construction equipment and other construction loadings. The plan shall indicate for all trench conditions the minimum horizontal distances from the side of the trench at its top to the near side of the surcharge loads.
4. The Sheeting and Shoring Plan is submitted for record purposes only. The acceptance of the plan only indicates the submission of plan and does not imply approval of the plan or relieve registered engineer responsibility for the plan. Nothing contained in the section shall be construed as relieving the CONTRACTOR of the full responsibility for providing shoring, bracing, sloping, or other provisions which are adequate for worker protection.
5. Nothing in this section is intended to relieve the CONTRACTOR of his responsibility to carefully examine the CONTRACT DOCUMENTS and the site where the Work is to be performed; to familiarize himself with all the local conditions and federal, state, and, local laws, ordinances, rules, and regulations that may affect the performance of any Work; to study all surveys and investigation reports about subsurface and latent physical conditions pertaining to the site; to perform any additional surveys and investigations as the CONTRACTOR deems necessary to complete the Work at his bid price; and to correlate the results of all such data with the requirements of the CONTRACT DOCUMENTS.

SECTION 02150 – SHEETING AND SHORING

1.4 ALTERNATIVES

- A. The use or application of alternative methods and materials, and the employment of proprietary systems under lease or franchise in lieu of that specified herein, may be allowed. Demonstration of suitability and compliance with these Specifications to the satisfaction of the RESIDENT ENGINEER will be required.

1.5 SAFETY

- A. Except as otherwise indicated, the following codes apply to the Work of this Section:
 - 1. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork, Section 1542, Shafts.

PART 2 MATERIALS

2.1 PRODUCTS

- A. Use new or used materials complying with provisions of the approved shoring, bracing and sheeting design drawings. Materials shall be free from defects and damage that might in any way impair their protective function.
- B. Steel sheet piling shall be continuous interlocking type ASTM A 328 of appropriate shape and provided with at least one 2-1/2-inch-diameter handling hole on the centerline of the web located at least 6 inches from each end of the sheet pile.
- C. Fabricated connections and accessories, steel H-piles, WF shapes, and other structural steel shall conform to the requirements of ASTM A 36, unless otherwise approved.
- D. Concrete shall be as specified in Section 03300.
 - 1. For encasement of steel soldier piles below the final level of excavation, 2,500 psi shall be used.
- 2. For encasement of soldier piles above the final level of excavation, lean concrete shall be used, the strength of which shall be adequate to protect the excavated faces of the augured hole.
- E. Wood lagging shall be dimension lumber with minimum allowable stress of 1100 psi.

SECTION 02150 – SHEETING AND SHORING

1. The stress grade of the lagging shall be in conformance with the allowable stresses of the UBC, Chapter 25.
2. Lumber shall be grade marked by WWPA or WCLIB with species and grade conforming with those shown on approved Shop Drawings.

PART 3 EXECUTION

3.1 GENERAL

- A. The support system shall extend the main excavation bottom elevation to a depth adequate to prevent lateral movement and to adequately support applied vertical loads. In areas where additional excavation is required below the main excavation subgrade provisions shall be made to prevent movement of main excavation supports. Damage to existing utilities during installation of excavation support system shall be avoided. In flow of ground water shall be prevented and the base of the excavation subgrade shall be maintained in a stable, intact state.

3.2 SOLDIER PILES

- A. Soldier piles shall be installed by pre-boring or other approved pre-excavation methods to tip elevation shown on approved Shop Drawings. Prevent pre-bored or other pre-excavated holes from collapsing.
- B. Pre-bored hole shall be filled with lean concrete from bottom of hole to subgrade dependent upon analysis of vertical support requirements.
- C. Remaining pile length shall be filled with lean concrete, completely encasing the pile.
- D. Concrete shall be placed from the bottom of the hole upwards by means of a flexible pipe connected to a hopper.

3.3 SHEETING AND LAGGING

- A. Sheeting and lagging shall be installed with no gap between the boards unless specifically approved. As installation progresses, the voids between the excavation face and the lagging or sheeting shall be backfilled with sand or soil rammed into place. Materials such as hay or burlap shall be used where necessary to allow drainage of groundwater without loss of soil or packing material. If gaps in the lagging are allowed, the gap width between lagging boards shall be limited to 1/2-inch maximum.

SECTION 02150 – SHEETING AND SHORING

- B. If unstable material is encountered, suitable measures shall be taken to retain it in place or to otherwise prevent soil displacement.
- C. Extend lagging down to final subgrade.
- D. A sufficient quantity of material shall be on hand for sheeting, shoring, bracing, and other operations for protection of work and for use in case of accident or emergency.

3.4 STEEL SHEET PILING

- A. Steel sheet piling may be used only where existing subsurface conditions are suitable for installation of sheet piling to the full depth of penetration required, and to proper alignment and plumbness, specified herein, without damage to the sheet piling or rupture of its interlocks. The use of steel sheet piling will not be permitted where sheeting would be required to penetrate boulders, rock or other materials which may prevent the proper installation of sheet piling.
- B. Steel sheet piling shall be installed in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Install sheeting to depth required for design. Exercise care during installation so that interlocking members can be extracted, if required, without injury to adjacent ground. The installation equipment shall be suitable to the type and nature of the subsurface materials anticipated to be encountered. The equipment and methods of installation, cutting, and splicing shall conform to the approved Shop Drawings.
- C. Liner plate shall be installed to proper line and grade and dimensions which will enable final liner to be placed in accordance with tolerances specified by the Engineer. Annular void, if present by method of ground support shall be filled with tunnel grout as specified by the Engineer.

3.5 INTERNAL BRACING SUPPORT SYSTEM

- A. All bracing support members shall be installed and maintained in tight contact with each other and with the surface being supported.
- B. Bracing members shall be preloaded by jacking the struts and shores in accordance with loads, methods, procedures, and sequence as described on the approved Shop Drawings. Coordinate excavation work with bracing installation and preloading. Use steel shims and steel wedges welded or bolted in place to maintain the preloading force in the bracing after release of

SECTION 02150 – SHEETING AND SHORING

the jacking equipment pressure. Use procedures so as to produce uniform bracing member loading without appreciable eccentricities, overstressing, or support member distortion.

- C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.
- D. Excavations shall be to a depth no more than 2-feet below the elevation of the support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation.

3.6 REMOVAL OF SUPPORT SYSTEMS

- A. Where removal is required wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with lean concrete, or other approved means.
- B. All elements of support systems shall be removed to a minimum depth of 6-feet below final ground surface. However, when a structure poured against the sheeting system extends above the 6-foot limit, removal of the sheeting system shall be to the top of the structure.
- C. All damage to property resulting from removal shall be promptly repaired at no cost to the RESIDENT ENGINEER. The Engineer shall be the sole judge as to the extent and determination of the materials and methods for repair

**** END OF SECTION ****

SECTION 02200 – EARTHWORK

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall perform all earthwork required for construction of the Work. The Work includes the loosening, removing, loading, transporting, depositing, and compacting in their final locations of all materials, wet and dry. The CONTRACTOR shall comply with all local, state and federal safety and health standards, laws and regulations.

1.2 DEFINITIONS

- A. Fill material is defined as material used to raise the level of a portion of the site to the line and grade indicated.
- B. Backfill material is defined as material used to refill an excavation. Backfill material is defined as starting 1 foot above the top of the pipe or conduit, or at the subgrade for cast-in-place structures such as vaults and valve boxes.
- C. Bedding material is defined as material within the pipe zone that supports and surrounds pipe or conduit.
- D. The pipe zone is generally defined as the area that extends from 6 inches below the bottom of the pipe to 1 foot above the top of the pipe. For steel pipe, the pipe zone begins 4 inches below the bottom of the pipe.

1.3 RELATED SECTIONS

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

1.	Section 02050	Demolition
2.	Section 02100	Site Preparation
3.	Section 02150	Sheeting and Shoring
4.	Section 02274	Geotextiles
5.	Section 02630	Ductile Iron Pipe
6.	Section 02645	PVC Pressure Pipe (4 in. and Smaller)
7.	Section 02646	PVC Pressure Pipe (Larger than 4-inch)
8.	Section 02760	Compact Proprietary Biofiltration BMPs
9.	Section 02768	Permeable Interlocking Concrete Pavers
10.	Section 02810	Landscape Irrigation System
11.	Section 02831	Industrial Ornamental Metal Fencing
12.	Section 02900	Landscape Planting
13.	Section 03300	Cast-in-Place Concrete
14.	Section 03310	Cast-in-Place Site Work Concrete
15.	Section 03400	Precast Concrete

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16. Section 04232 Reinforced Concrete Block Masonry

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with current versions, with revisions, of the following:
1. California Building Code.
 2. Construction Safety Orders, Division of Industrial Safety, State of California.
 3. California Department of Transportation Traffic Manual.
- C. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:
1. ASTM C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 2. ASTM D 75 Practice for Sampling Aggregates
 3. ASTM D 1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 4. ASTM D 1557 Test Method for Moisture-Density Relations of Soils Using a Modified Effort
 5. ASTM D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 6. ASTM D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 7. ASTM D 3017 Test Method for Moisture Content of Soil and Rock in Place by Nuclear Methods
 8. ASTM D 2922 Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods.
 9. ASTM D 4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using Vibratory Plate
 10. ASTM D 4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- D. The following documents were prepared for this project and are available as <ftp://ftp.sannet.gov/OUT/ECP/La%20Jolla%20View%20Reservoir/>.

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Geotechnical Investigation, La Jolla Country Club Reservoir and Pump Station Project, La Jolla, California, prepared by Southern California Soil and Testing, Inc., February 28, 2012.

Updated Seismic Design Criteria, La Jolla Country Club Reservoir and Pump Station Project, La Jolla, California, prepared by Southern California Soil and Testing, Inc., July 21, 2014.

Infiltration Rate Potential, La Jolla Country Club Reservoir and Pump Station Project, La Jolla, California, prepared by Southern California Soil and Testing, Inc., November 3, 2015.

1.5 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 – Submittals:
1. A copy of the excavation permit issued by the California Department of Industrial Safety.
 2. Samples of imported material in accordance with the latest edition of SSPWC.
 3. Such other samples of materials as the RESIDENT ENGINEER may require.
 4. Nothing contained in the section shall be construed as relieving the CONTRACTOR of the full responsibility for providing shoring, bracing, sloping, or other provisions which are adequate for worker protection.
 5. Nothing in this section is intended to relieve the CONTRACTOR of his responsibility to carefully examine the CONTRACT DOCUMENTS and the site where the WORK is to be performed; to familiarize himself with all the local conditions and federal, state, and, local laws, ordinances, rules, and regulations that may affect the performance of any WORK; to study all surveys and investigation reports about subsurface and latent physical conditions pertaining to the site; to perform any additional surveys and investigations as the CONTRACTOR deems necessary to complete the WORK at his bid price; and to correlate the results of all such data with the requirements of the CONTRACT DOCUMENTS.

PART 2 – PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

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- A. **General:** Fill and backfill material shall consist of select material obtained from the excavation, imported material, bedding material, or unclassified material. B. **Select Material:** Select material shall consist of primarily granular material obtained from the excavation which is free of vegetation, organic matter, rubbish, debris, rocks larger than 3-inches in diameter and other unsuitable material, has an expansion index less than 20 as determined by CBC Standard No. 29-2, has a plasticity index of 10 or less, has a liquid limit of 30 or less, and is approved as select material by the RESIDENT ENGINEER.
- 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. The CONTRACTOR shall obtain approval by the RESIDENT ENGINEER before transporting imported material.
- D. **Bedding Material:** Bedding material shall be sand, gravel, crushed aggregate or free draining material in accordance with the latest edition of the SSPWC, including the Regional and City Supplement Amendments.
- E. **Unclassified Material:** Unclassified material shall conform to the latest edition of the SSPWC, except that material shall not contain rocks or lumps over 4 inches and not contain over 40 percent greater than 3/4 inches in dimension.
- F. **Structure Backfill:** Structure backfill shall conform to SSPWC Subsection 217-3.
- G. **Controlled Low Strength Material (CLSM) Backfill:** When ordered or approved by the RESIDENT ENGINEER, backfill shall conform to SSPWC Subsection 201-6.

2.2 ROCK PRODUCTS

- A. Rock products, consisting of crushed rock, rock dust, gravel, sand, and stone for riprap shall be clean, hard, sound, durable, uniform in quality, and free of disintegrated material, organic matter, oil, alkali, or other deleterious substance, and shall, unless otherwise specified, conform to the requirements of SSPWC Subsection 200-1.

2.3 UNTREATED BASE MATERIALS

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

2.4 TOPSOIL

SECTION 02200 – EARTHWORK

- A. Topsoil shall be designated as Class B selected and shall conform to the requirements of SSPWC Subsection 800 and Section 02900 – Landscaping. The CONTRACTOR shall submit an agricultural soil evaluation regarding the suitability of the proposed topsoil.

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 reasons of his activities. The necessary precautionary measures shall conform to the requirements of the latest edition of SSPWC.
- B. All types of earthwork, including trench, structural and general excavation, fill, backfill and compaction, shall conform to applicable requirements of the latest edition of SSPWC and to the requirements specified herein.
- C. Pursuant to California Code of Regulations, Title 8, Section 1541, at least two working days before the start of excavation, the CONTRACTOR shall notify the Regional Notification Center and known owners of underground facilities in the area who are not members of the Regional Notification Center of the proposed excavation.

3.2 SITE PREPARATION

- A. Areas to be excavated, filled, graded, and to be occupied by permanent construction or embankments shall be prepared by clearing, grubbing and stripping. Clearing, grubbing and stripping shall conform to the applicable requirements of SSPWC Subsection 300-1 and Section 02100. The CONTRACTOR shall prepare for a Storm Water Pollution Prevention Plan in accordance with the requirements of Regional Water Quality Control Board General Permit..
- B. **Pump Station.** Existing soil should be excavated to a depth of three (3) feet below the planned footing bottom elevation. Any existing fill, if any, should be excavated in its entirety. Horizontally, the excavation should extend at least five (5) feet outside of the perimeter footings or up to the existing improvements, whichever is less.
- C. **Reservoir.** It is expected that once demolition is completed, the formational material will be exposed at the planned reservoir bottom. Existing fill, wet soil, or other unsuitable material shall be removed in its entirety. The excavated

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material shall be replaced with three sack sand/cement slurry or lean concrete.

- D. Hardscape. The material within one (1) foot of planned subgrade elevation shall be excavated beneath pavements and hardscape. Horizontally, the excavation should extend at least 2 feet outside planned improvements or up to the existing improvement, whichever is less.

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 accordance with SSPWC Subsection 300-2.6.
- C. **Structure Excavation:** Structure excavation shall consist of the removal of material for the construction of foundations for bridges, retaining walls,

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headwalls, culverts, buildings, or other structures, and shall be in accordance with SSPWC Subsection 300 3.

1. Cofferdams for foundation construction shall be constructed in accordance with SSPWC Subsection 300-3.2.
2. The treatment of foundation material shall be in accordance with SSPWC Subsection 300-3.3.

D. Underground Conduit Excavation:

1. **General:** Excavation for underground conduits shall be in accordance with the latest edition of SSPWC. Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the CONTRACTOR.
2. **Sheeting, Shoring, and Bracing of Excavations:** The manner of sheeting, shoring, and bracing excavations shall be as set forth in the rules, orders and regulations of the Division of Industrial Safety of the State of California, and in accordance with the requirements of the latest edition of SSPWC. Sheeting, shoring, and bracing shall be provided for the protection of life and limb, for the protection of existing underground and above-ground structures and improvements, and shall conform to applicable safety orders. Sheeting, shoring, and bracing shall be provided to prevent trench sluffing, pavement separation and similar problems during construction, and shall include furnishing, installation, maintenance, and removal.
3. **Trench Bottom:** Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required.
4. **Open Trench:** The maximum length of open trench permitted in any one location is 500 feet or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The top of the steel plates shall be set flush with the top of the adjacent pavement, and the plates shall be surfaced for improved vehicular traction. The above requirements for backfilling or use of steel plate will be waived in cases

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where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, the CONTRACTOR shall provide and maintain barricades and warning lights conforming to requirements set forth in the California Department of Transportation Traffic Manual.

5. **Trench Over-Excavation:** Where the Drawings indicate that trenches shall be over-excavated, they shall be excavated to the depth required, and then backfilled to the grade of the bottom of the pipe.
6. Where pipelines are to be installed in embankment fills, the fill shall be constructed to a level at least one-foot above the top of the pipe before the trench is excavated.

E. Over-Excavation of Building Structure Pad:

Grading for the building structure will result in a cut-fill transition. After excavating to the specified grades for the building structure pad, the cut portion of the pad shall be over-excavated by one-third or more of the deepest fill depth beneath the structure or 3 feet, whichever is greater, and replaced with Unclassified Material placed in accordance with SSPWC Section 300-4.5. The over-excavation shall be extended outward from the building footprint to a distance of 5 feet plus the depth of over-excavation. All work specified in this Section shall be performed by the CONTRACTOR at no additional cost to the OWNER when the over-excavation as ordered is within the building structure limit shown on the Drawings plus the limits said herein.

In lieu of over-excavation of the building structure pad, the CONTRACTOR may submit a substitution for approval at no additional cost to the OWNER. The substitution shall provide that where foundations are underlain by fill, the foundation excavation is deepened to bear on undisturbed formational materials. The deepened excavation shall be replaced with Controlled Low Strength Material (CLSM).

F. Over-Excavation Ordered by RESIDENT ENGINEER:

Trenches shall be over-excavated beyond the depth shown when required by the RESIDENT ENGINEER. Such over-excavation shall be to the depth ordered by the RESIDENT ENGINEER. The over-excavation shall then be backfilled using 3/4-inch crushed rock underlain by an approved woven geotextile. The CONTRACTOR shall then place bedding material over the crushed aggregate. All work specified in the Section shall be performed by the CONTRACTOR at no additional cost to the OWNER when the over-excavation ordered by the RESIDENT ENGINEER is within 6 inches of the limit shown on the Drawings. When the over-excavation ordered by the RESIDENT ENGINEER is 6 inches more than the limit shown on the Drawings, additional payment will be made to the CONTRACTOR for the portion that exceeds the said 6-inch distance.

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- G. Over-Excavation not Ordered or Indicated: Any over-excavation carried below the grade ordered or indicated shall be backfilled to the required grade with material specified by the RESIDENT ENGINEER and the material shall be compacted. Such work shall be performed by the CONTRACTOR at no additional cost to the OWNER.
- H. Excavation in Landscaped Areas:
1. Where excavation occurs in landscaped areas, the plants shall be carefully removed and stockpiled to preserve it for replacement. Excavated material may be placed on the project site. Immediately after completion of backfilling [and testing of the pipeline], the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition. .
 2. The CONTRACTOR shall restore the irrigation system per Section 02810 – Landscape Irrigation Systems.
- I. Excavation in Vicinity of Trees: Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2-inches in diameter shall be cut without written permission of the RESIDENT ENGINEER. Trees shall be supported during excavation by means previously reviewed by the RESIDENT ENGINEER.
- J. Rock Excavation:
1. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.
 2. Rock excavation shall be performed by the CONTRACTOR, however, should the quantity of rock excavation be affected by any change in the scope of Work, an appropriate adjustment of the contract price will be made.
- K. Excavation Beneath Concrete Reservoir: Unless otherwise specified or shown, excavation under the reservoir shall extend to the bottom of the drainrock layer. It shall be verified by the RESIDENT ENGINEER and the Geotechnical Representative that the reservoir excavation also extends a minimum of 6-inches into competent native rock material. Competent native rock material (undisturbed, firm igneous bedrock materials) is defined as igneous rock. A modulus of subgrade reaction, k of 150 pounds per cubic inch (pci) is considered appropriate for the analysis of immediate settlements under raft

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foundations supported on the formational material. Additionally a bearing value of 5,000 lbs/sq. ft. may be used and may be increased by ½ when considering the total of all loads, including wind or seismic forces. Additional excavation may be required to insure the reservoir is founded on competent native material. A change order will be issued for any additional excavation and any backfilling required. After such excavation has been completed, the resulting subgrade surface shall be cleaned of all loose rock, dirt, slough and disturbed material and the resulting surface examined for indications of weak or disturbed materials not capable of bearing the design loads. Where needed, as determined by the RESIDENT ENGINEER, the exposed surface shall be over excavated to firm bedrock and the resulting excavation in filled with 4-sack cement slurry. If the cause of the ordered over excavation is due to CONTRACTOR negligence as determined by the RESIDENT ENGINEER, no additional compensation shall be afforded to the CONTRACTOR for the over excavation and backfill work. Other over excavation work shall be according to SSPW Section 3-3. If the foundation is excavated beyond the limits described above, the foundation shall be backfill to the bottom of the drainrock layer with 4-sack cement slurry. The 4-sack cement slurry shall be per this Section and the costs of the slurry backfilling shall be borne by the CONTRACTOR. The drainrock layer or any concrete shall not be placed until the foundation has been inspected and approved by the RESIDENT ENGINEER and the Geotechnical Representative.

- L. Excavation Around Reservoir: Preparation of the existing ground to receive the Reservoir Backfill will require excavation to competent rock material to provide a suitable foundation support for the proposed fill. No fill shall be placed until the area to be covered has been inspected and approved by the RESIDENT ENGINEER and the Geotechnical Representative.

3.4 FILL AND BACKFILL

A. General:

1. Fill and backfill shall be placed in accordance with the applicable provisions of the latest edition of SSPWC.
2. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any concrete structure until the concrete has cured in accordance with the requirements of Section 03300 – Cast-in-Place Concrete and has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Placing and Spreading of Materials:

1. Materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall

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be evenly spread so that when compacted each layer shall not exceed 8 inches in thickness. When compaction is achieved using flooding and jetting methods, each layer shall not exceed 3 feet in thickness after compaction.

2. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Bedding materials shall be brought up evenly around the pipe so that when compacted, the material will provide uniform bearing and side support.
3. Where the material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
4. Where the material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

C. Compaction Requirements

1. The CONTRACTOR will perform density and compaction tests in accordance with the latest edition of SSPWC .
2. The relative compaction of fill, backfill, and base material shall be in accordance with the latest edition of SSPWC, with the following exceptions:
 - a. Subgrade where trench has been over-excavated: 90%
 - b. Fill beneath structures, including water-containing structures: 90%
 - c. Backfill on underground structure roof: 90%
3. In case the tests of the backfill show non-compliance with the required compaction or density, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the RESIDENT ENGINEER and shall be at the CONTRACTOR's expense.

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

E. **Structure Backfill:** Backfill at structures shall be Structure Backfill material placed in accordance with SSPWC Subsections 300-3.5.

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F. Underground Conduit Bedding and Backfill:

1. Bedding around pipe shall be bedding material placed in accordance with the requirements of SSPWC Subsection 306-6 except as noted. Water pipes shall be bedded in accordance with Standard Drawings SDW-107 and SDW-110. Bedding material shall be sand, gravel, crushed rock, or native free-draining granular material having a sand equivalent of not less than 50 and an expansion when saturated with water of not more than 0.5 percent. Bedding material shall be mechanically compacted. The relative compaction of the conduit bedding shall be 90 percent. Neither flooding nor jetting will be allowed for compaction of the bedding.
2. If bedding material consists primarily of gravel or crushed rock, the bedding material shall be wrapped using an approved nonwoven geotextile filter fabric. Geotextile filter fabric will not be required where sand is used for bedding material or where the excavation is through rock.
3. Upon completion of the bedding and following placement of the pipe or conduit, trench backfill shall be placed and densified in accordance with SSPWC Subsection 306-12. Backfill shall be Select Material, or Controlled Low Strength Material (CLSM) where approved by the RESIDENT ENGINEER. Trench backfill shall be mechanically-compacted trenched backfill shall be placed in accordance with the requirements of SSPWC Subsection 306-12. Water jetting shall not be allowed.
4. Trench backfill shall be compacted to obtain a minimum 90 percent relative compaction. The top foot of the trench backfill shall be densified to a minimum of 95 percent relative compaction except in unimproved areas. Only lightweight tamping equipment shall be used within 3 feet of the pipe, conduit, or appurtenance. Testing of compaction will be performed by the City Materials and Testing Lab.
5. Separate payment for imported backfill will be made only when select material from the excavation is unavailable, when the excavation is in heavy clay, when the excavation is in highly expansive soil, or when the soil has other deleterious properties as determined by the RESIDENT ENGINEER. The RESIDENT ENGINEER will decide whether the excavated material is suitable for backfill and when separate payment will be made for imported backfill. Where imported backfill is required, the unit Bid price for imported backfill shall include the cost for disposal of all unsuitable materials excavated from the trench.

3.5 PREPARATION OF SUBGRADE

- A. The preparation of subgrade for slab-on-grade, pavement, curbs and gutters, driveways, sidewalks and other roadway structures shall be in accordance

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with SSPWC Subsection 301-1. The upper 12 inches of pavement subgrade shall be scarified, moisture conditioned, and recompactd to 90% of relative compaction.

3.6 UNTREATED BASE

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

3.7 TEMPORARY STOCKPILES

- A. Locations of temporary stockpiles shall be approved by the RESIDENT ENGINEER
- B. Temporary stockpiles shall not surcharge buried pipe, conduits or other structures.

****END OF SECTION****

SECTION 02274 – GEOTEXTILES

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide geotextiles, complete and in place, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 02200 Earthwork
- 3. Section 02760 Compact Proprietary Biofiltration BMPs
- 4. Section 02768 Permeable Interlocking Concrete Pavers

1.3 DEFINITIONS

- A. The following definitions apply to the Work of this Section:

- 1. Fabric. Geotextile, a permeable geosynthetic comprised solely of textiles.
- 2. Minimum Average Roll Value (MinARV). Minimum of series of average roll values representative of geotextile provided.
- 3. Maximum Average Roll Value (MaxARV). Maximum of series of average roll values representative of geotextile provided.
- 4. Nondestructive Sample. Sample representative of finished geotextile, prepared for testing without destruction of geotextile.
- 5. Overlap. Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- 6. Seam Efficiency. Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

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B. Except as otherwise indicated, the current editions of the following apply to the work of this section.

1. ASTM D 3786 Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
2. ASTM D 3787 Standard Test Method for Bursting Strength of Knitted Goods - Constant-Rate-of-Travel (CRT) Ball Burst Test
3. ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
4. ASTM D4354 Sampling of Geosynthetics for Testing
5. ASTM D 4491 Standard Test Method for Water Permeability of Geotextiles by Permittivity
6. ASTM D 4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles
7. ASTM D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
8. ASTM D 4751 Test Method for Determining the Apparent Opening Size
9. ASTM D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
10. ASTM D 4873 Standard Method for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.5 CONTRACTOR SUBMITTALS

- A. General. Submittals shall be in accordance with the requirements of Section 01300 - Submittals.
- B. Quality Assurance. The CONTRACTOR shall provide the following shop drawings:
 1. Manufacturer material specifications and product literature.

SECTION 02274 – GEOTEXTILES

2. Installation drawings showing geotextile sheet layout, location of seams, and direction of overlap.
 3. Description of proposed method of geotextile deployment, equipment, and provisions for holding geotextile temporarily in place until permanently secured.
- C. Sampling and Test Compliance. Sampling and test compliance shall be in accordance with SSPWC Subsection 213-3.
- D. Certifications. A manufacturer's certificate shall be provided to the Owner's Representative in accordance with SSPWC Subsection 213-1.

1.6 PROTECTION AND IDENTIFICATION

- A. Geotextiles shall be protected and identified in accordance with SSPWC Subsection 213-2.

1.7 STORAGE AND HANDLING

- A. Storage and handling shall comply with SSPWC Subsection 213-2 and as indicated herein.

PART 2 MATERIALS

2.1 NONWOVEN GEOTEXTILE

- A. Nonwoven geotextiles shall comply with SSPWC Subsection 213-5.
- B. The minimum unseamed sheet width shall be 6 feet.
- C. The nominal weight per square yard shall be 16 oz minimum.
- D. Physical properties of non-woven geotextiles shall conform to Type 90N as identified in SSPWC Table 213-5.2 (A).

PART 3 EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall notify the RESIDENT ENGINEER before geotextiles are placed. The CONTRACTOR shall not place geotextiles before obtaining the RESIDENT ENGINEER'S approval of the underlying materials.
- B. Geotextiles shall be placed free of tension, folds, wrinkles, or creases.

SECTION 02274 – GEOTEXTILES

3.2 GEOTEXTILES FOR TRENCH DRAINS

- A. Geotextiles for trench drains shall be placed in accordance with SSPWC Subsection 300-8.1.

3.3 REPAIRING GEOTEXTILE

- A. The CONTRACTOR shall repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. The CONTRACTOR shall repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18- inches in all directions beyond damaged area. The CONTRACTOR shall remove interfering material as necessary to expose damaged geotextile for repair. The CONTRACTOR shall sew patches or secure them with pins and washers, or by other means approved by RESIDENT ENGINEER.

**** END OF SECTION ****

SECTION 02630 – DUCTILE IRON PIPE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide and install ductile iron pipe and all appurtenant work.
- B. The Work requires that one pipe manufacturer accept responsibility for furnishing the coated and lined pipe without altering or modifying the CONTRACTOR's responsibilities under the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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 01040 | Coordination |
| 2. | Section 01300 | Submittals |
| 3. | Section 01730 | Operation and Maintenance Information |
| 4. | Section 02200 | Earthwork |
| 5. | Section 02666 | Water Pipeline Testing and Disinfection |
| 6. | Section 03300 | Cast-in-Place Concrete |
| 7. | Section 09800 | Protective Coating |
| 8. | Section 15000 | Piping Components |
| 9. | Section 15020 | Pipe Supports |
| 10. | Section 16640 | Cathodic Protection |

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. AWWA C104/ANSI A21.4 Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 2. AWWA C105/ANSI A21.5 Polyethylene Encasement For Ductile-Iron Pipe Systems
 - 3. AWWA C111/ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 4. AWWA C115/ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Treaded Flanges

SECTION 02630 – DUCTILE IRON PIPE

- | | | |
|-----|-----------------------|---|
| 5. | AWWA C110/ANSI A21.10 | Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids |
| 6. | AWWA C150/ANSI A21.50 | Thickness Design of Ductile-Iron Pipe |
| 7. | AWWA C151/ANSI A21.51 | Ductile Iron Pipe, Centrifugally Cast, for Water |
| 8. | AWWA C153/ANSI A21.53 | Ductile-Iron Compact Fittings, 3 in. through 24 inches and 54 through 64 inches for Water Service |
| 9. | AWWA C217 | Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines |
| 10. | ASTM A674 | Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids |
| 11. | ASTM D 16 | Definition of Terms Relating to Paint, Varnish, Lacquer, and Related Products |
| 12. | ASTM D 471 | Test Method for Rubber Property - Effect of Liquids |
| 13. | ASTM D 1248 | Polyethylene Plastics Molding and Extrusion Materials |
| 14. | ASTM D 2240 | Test Method for Rubber Property - Durometer Hardness |
| 15. | ASTM D 4060 | Test Method for Abrasion Resistance of Organic Coatings by Taber Abraser |
| 16. | ASTM D 4541 | Method for Pull-Off Strength of Coatings using Portable Adhesion Testers |
| 17. | ASTM E 96 | Test Methods for Water Vapor Transmission of Materials |
| 18. | ASTM G 14 | Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test) |

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
1. Certified dimensional drawings of all valves, fittings, and appurtenances.

SECTION 02630 – DUCTILE IRON PIPE

2. Shop drawings and design calculations for joint restraint systems using reinforced mechanical restraining glands or harnesses.
3. Drawings and calculations for thrust blocks.

1.5 OPERATION AND MAINTENANCE INFORMATION

- A. A certified affidavit of compliance for pipe and other products or materials with the requirements of this Section shall be provided with the operation and maintenance information described in Section 01730 - Operation and Maintenance Data. .

1.6 FACTORY INSPECTION AND TESTS

- A. Quality Control: The CONTRACTOR shall comply with the requirements of Section 01400 -Quality Control.
- B. Inspection: All pipe and fittings shall be subject to inspection at the place of manufacture and place of coating and lining application in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the RESIDENT ENGINEER in writing of the manufacturing starting date not less than 14 calendar days before the start of the pipe manufacture and coating application.
- C. Access: During the manufacture of the pipe and fittings, the RESIDENT ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- D. Testing: Except as modified herein, all materials used in the manufacture of the pipe and fittings shall be tested in accordance with the requirements of the referenced standards as applicable.
- E. Costs of Testing: The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The RESIDENT ENGINEER will witness all testing conducted by the CONTRACTOR; provided that the CONTRACTOR's schedule is not delayed for the convenience of the RESIDENT ENGINEER.
- F. Additional Samples: In addition to those tests specifically required, the RESIDENT ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

1.7 MARKING, HANDLING, AND STORAGE

- A. All pipe and fittings shall be factory marked in the referenced specifications. Mark the surface of each fitting and special that is intended to be at the top when the fitting or special is placed in the trench..

SECTION 02630 – DUCTILE IRON PIPE

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pipe and Fittings: Ductile iron pipe and fittings shall conform to the requirements of SSPWC Subsection 209-1.1 and the requirements specified herein. The pipe shall be of the diameter and class indicated on the Drawings. Wall thickness design shall conform to AWWA C150 and C151.
- B. Bonding and Electrical Conductivity: Pipe joints shall be prepared for bonding for electrical conductivity in accordance with the details indicated on the Drawings. The CONTRACTOR shall furnish all materials required for joint bonding. To accommodate attachment of the joint bonding pad, which is used to eliminate damage to the interior pipe linings during alumino-thermal welding, a 2.5-inch x 2-inch x 3/8-inch thick ductile iron pad shall be welded on each end of the pipe before lining and coating. Following welding of the bond wires to the pipe, the exterior coating shall be repaired.

2.2 PIPE JOINTS

- A. Ductile iron pipe joints shall comply with the requirements of SSPWC Subsection 2079-1.1.2 and shall be of the type indicated on the Drawings.
- B. Restrained joints shall be TR FLEX as manufactured by United States Pipe and Foundry Company, MEGA LUG by Ebaa Iron, or approved equal.

2.3 MATERIALS

- A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of SSPWC Subsection 209-1.1.2 and AWWA C104, C105, C110, C111, and C151.
- B. Cement: Cement for mortar lining shall conform to the requirements of SSPWC Subsection 209-1.1.2 and AWWA C104. Cement for mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.

2.4 SPECIAL FITTINGS

- A. Fittings of the compact type for ductile iron pipe shall conform to the requirements of AWWA C153/ANSI A21.53, and shall have a minimum pressure rating of 250 psi.
- B. Fittings shall be of the diameter and class shown on the Drawings. Compact type fittings shall only be used where expressly specified.

2.5 CEMENT MORTAR LINING

- A. The internal surfaces of ductile iron pipe and fittings shall be lined with cement mortar and sealed in accordance with SSPWC Subsection 209-1.1.2 and AWWA

SECTION 02630 – DUCTILE IRON PIPE

C104, except that the minimum cement mortar lining thickness shall be double thickness in accordance with Section 4.7.2 of AWWA C104.

2.6 COATING OF EXPOSED PIPING

- A. Exposed piping shall be coated in accordance with Section 09800 - Protective Coating.

2.7 COATING OF BURIED PIPELINES

- A. General: Ductile iron pipe, fittings, and specials installed underground or underwater shall be coated with polyurethane in accordance with Section 09800 - Protective Coating.

2.8 FILL AND BACKFILL MATERIAL

- A. Fill and backfill materials shall be in accordance with Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

- A. Ductile iron pipe shall be installed in accordance with the applicable provisions of SSPWC Subsection 306-8 and the recommendations of the manufacturer.

3.2 PREPARATION

- A. The CONTRACTOR's operations shall comply in all respects with SSPWC Section 7.
- B. Utility relocation operations shall comply in all respects with SSPWC Section 5.

3.3 EXCAVATION

- A. Unless indicated otherwise, excavation and over excavation shall be in accordance with Section 02200 - Earthwork.
- B. The trench width shall be as indicated on the Drawings.

3.4 LAYOUT AND HANDLING

- A. Handling of Pipe and Accessories: Pipe shall be lifted in such a manner as to minimize bending and prevent damage to the pipe. During transport, pipe shall be supported to prevent distortion or damage to the pipe. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rocks larger than 3 inches eliminated. All pipe, fittings valves and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or

SECTION 02630 – DUCTILE IRON PIPE

accessories be dropped or dumped into the trench. The CONTRACTOR shall smooth out any burrs, gouges, or weld splatter and repair other defects prior to laying the pipe. Any pipe section, including coatings and linings, that becomes damaged as a result of handling or stockpiling shall be replaced with a new unit or repaired at the discretion of the RESIDENT ENGINEER at no additional cost to the OWNER.

3.5 INSTALLATION

- A. Interferences: Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the RESIDENT ENGINEER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.
- B. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the CONTRACTOR's laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one-inch plus or minus. No tolerance is permitted on pipes designed for zero slope.
- C. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and these specifications.
- D. Cutting and machining of the pipe shall be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- E. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the RESIDENT ENGINEER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the RESIDENT ENGINEER or a new undamaged pipe or appurtenance shall be provided.

SECTION 02630 – DUCTILE IRON PIPE

- F. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.
- G. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- H. Immediately before placing each section of pipe in final position for jointing, the pipe bedding shall be checked for firmness and uniformity of surface.
- I. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.
- J. Backfilling and compaction shall comply with Section 02200 - Earthwork.
- K. Sheet piling used for shoring shall extend at least 2 feet below the bottom of the trench. After completion of the pipe, it may be removed by cutting at least 12 inches above the top of the pipe. No vibratory methods for pile removal will be accepted, and piling lower than 12 inches above the top of the pipe shall be left in place.
- L. The CONTRACTOR shall lay sections of pipe with the bell end upgrade.
- M. Except for short runs which may be permitted by the RESIDENT ENGINEER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10 percent. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
- N. Where indicated on the Drawings, concrete thrust blocks shall be provided.
- O. Where the proposed piping will connect to existing piping which is in service, the CONTRACTOR shall isolate the existing system in order to make the necessary connections. Shutdown period shall be kept to a minimum.

SECTION 02630 – DUCTILE IRON PIPE

3.6 SACRIFICIAL ANODE FOR FITTINGS

- A. Each ductile-iron buried fitting shall have a zinc anode attached by a thermite welded wire at each fitting.
- B. Fittings 8-inch and larger shall have a 30 pound anode welded to each fitting.
- C. Fittings 6-inch and smaller shall have a 20 pound anode welded to each fitting.
- D. The buried reservoir inlet/outlet pipe, 16-inch diameter, and pump station discharge pipe shall be thermite welded between buried pipe and fittings for continuous conductivity.

3.7 CONNECTIONS TO EXISTING SYSTEM

- A. The CONTRACTOR shall coordinate with the City, make all arrangements for the shutdown of the existing distribution system, and make the connection between the new yard piping and the existing water main. For connection requirements, refer to Section 01040 – Coordination..

3.8 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection shall be in accordance with Section 02666 - Water Pipeline Test and Disinfection.

3.9 SITE RESTORATION

- A. Backfill and compaction shall be performed in accordance with Section 02200 - Earthwork.
- B. The CONTRACTOR shall place subgrade and base materials in accordance with Section 02200.
- C. The CONTRACTOR shall replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in SSPWC Subsection 306-1.5.2.
- D. The CONTRACTOR shall provide planting, mulching, or hydroseeding in the areas indicated on the Drawings. The CONTRACTOR shall grade the surface as indicated on the Drawings.

3.10 PIPELINE MARKING TAPE

- A. Install continuous plastic marking tape in accordance with the requirements of SDM-105.

3.11 CORROSION CONTROL

- A. Use of Noncorrosive Material: the corrosion control strategy includes the use of noncorrosive piping material whenever feasible.

SECTION 02630 – DUCTILE IRON PIPE

- B. Low Pressure (725 Zone) Pipe: the corrosion control strategy is to use C900 PVC piping and ductile iron mechanical joint fittings except for 16-inch reservoir inlet/outlet pipe, which is all to be cement mortar lined and coated steel. For cathodic protection requirements see Section 16640 – Cathodic Protection.
- C. High Pressure (925 Zone) Buried Pipe: The pipe is C900 PVC with ductile iron fittings. For cathodic protection requirements see Section 16640 – Cathodic Protection.
- D. All buried bolts and fasteners shall be “low alloy” steel composition for mechanical joints.
- E. All buried bolts and fasteners and fittings shall be completely encased and wrapped with a field petrolatum (wax-tape) coating conforming to AWWA C217.
- F. Wax Tape Coating System: All buried ductile iron piping and fittings shall be completely wrapped with Polyethylene encasement per AWWA C105.

**** END OF SECTION ****

SECTION 02644 – PVC NONPRESSURE PIPE

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide underground PVC nonpressure pipe and all appurtenant work, complete in place.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 1730 Operation and Maintenance Information
 - 2. Section 02200 Earthwork
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 03300 Cast-in-Place Site Work Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 2. ASTM D 3033 Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - 3. ASTM D 3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - 4. ASTM F679 Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

1.4 CONTRACTOR SUBMITTALS

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

SECTION 02644 – PVC NONPRESSURE PIPE

1. Samples of all the materials proposed for use on the Work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and installation instructions.
2. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted compliance with Section 01730 - Operations and Maintenance Information:
 1. Manufacturer's certificates of compliance indicating that all materials furnished under this Section meet the requirements of the Contract Documents.

1.6 HANDLING

- A. Handling of the PVC pipe shall be done in accordance with manufacturer's instructions to ensure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.

1.7 FACTORY TESTING

- A. The manufacturer shall perform all tests and submit the test results data and certification in compliance with SSPWC Subsection 207-17.4.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC pipe, fittings, couplings and appurtenances shall comply with SSPWC Subsection 207-17, and shall conform to the requirements of ASTM D3034, or Schedule 40/80 where indicated. Perforated pipe, where indicated, shall meet AASHTO M278 Standard.
- B. In addition to the identification marks specified in SSPWC 207-17.2.1, the CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.
- C. All PVC pipe shall be suitable for joining by compression joints unless otherwise shown or indicated.

SECTION 02644 – PVC NONPRESSURE PIPE

2.2 BEDDING MATERIAL AND BACKFILL

- A. Unless otherwise indicated, all material used for pipe bedding shall conform to the requirements of SSPWC Subsection 306-6 and Section 02200 Earthwork, and trench backfill material shall comply with the requirements in Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the RESIDENT ENGINEER, and shall be subject to his approval before acceptance.
- B. Installation shall conform to the recommendations of pipe manufacturer, the requirements of ASTM D 2321, SSPWC Subsection 306-7.7, and as indicated herein.
- C. Traffic: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 7.
- D. Utility Relocation: The CONTRACTOR's operations shall comply in all respects with SSPWC Section 5.

3.2 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Sections 02200 - Earthwork and SSPWC Subsection 306-3 and 306-7.7.
- B. The minimum depth of cover over the top of the pipe shall be 36 inches unless otherwise shown. Trench widths shall be as shown on the Drawings.
- C. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

3.3 LAYING PIPE

- A. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the CONTRACTOR for safe and efficient execution of the Work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as

SECTION 02644 – PVC NONPRESSURE PIPE

to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or will produce ragged, uneven edges.
- D. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- E. Where indicated that the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, this Work shall be performed at the CONTRACTOR's expense.

3.4 FIELD JOINTING

- A. Pipe shall be jointed in compliance with manufacturer's printed instructions.
- B. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. No pipe shall be laid when, in the opinion of the RESIDENT ENGINEER, the trench conditions or weather are unsuitable for such work.

3.5 INSTALLATION OF BENDS, TEES, AND REDUCERS

- A. Fittings shall be installed using standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to ensure a sound and proper joint.

SECTION 02644 – PVC NONPRESSURE PIPE

3.6 COMPACTION OF PIPE BEDDING AND BACKFILL

- A. Compaction of pipe bedding and trench backfill material shall conform to the requirements of Section 02200 - Earthwork.

3.7 TESTING

- A. Field testing of pipe shall conform to the applicable requirements of Section 02666 - Water Pipeline Testing and Disinfection.

**** END OF SECTION ****

SECTION 02645 – PVC PRESSURE PIPE (4 IN. AND SMALLER)

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing solvent-welded, polyvinyl chloride (PVC) piping as indicated, including fittings and accessories as required for a complete and operable piping system, up to and including 4-inch diameter pipe.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 02200 Earthwork
- 3. Section 02666 Water Pipeline Testing and Disinfection
- 4. Section 02810 Landscape Irrigation System
- 5. Section 09800 Protective Coating
- 6. Section 15000 Piping Components
- 7. Section 15020 Pipe Supports
- 8. Section 15030 Piping Identification Systems

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the Uniform Plumbing Code as adopted by the City of San Diego.
- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ASTM D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

SECTION 02645 – PVC PRESSURE PIPE (4 IN. AND SMALLER)

2. ASTM D 1785 Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
3. ASTM D 2467 Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
 1. Detailed layout, spool or fabrication drawings showing pipe spools, spacers, adaptors, connectors, fittings and pipe supports not indicated in the Contract Documents.
 2. Manufacturer's product data.
 3. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 1. Manufacturer's installation instructions.
 2. Manufacturer's certification of compliance with these specifications.

1.6 PROJECT RECORD DRAWINGS

- A. For concealed field-routed piping, the CONTRACTOR shall provide Record Drawings in compliance with the latest edition of SSPWC. The Record Drawings shall be complete layout drawings indicating the location of the pipeline as installed, with dimensions, the length and depth of all pipe runs, offsets from structures and other facilities, and the locations of bends, fittings, specials, and appurtenances.

1.7 FACTORY TESTING

- A. Product Testing: PVC pipe shall be tested at the factory for compliance with the minimum burst pressure requirements as specified in ASTM D 1785, using the test method specified in ASTM D 1599.
- B. Witnesses: The RESIDENT ENGINEER reserves the right to witness factory tests.

SECTION 02645 – PVC PRESSURE PIPE (4 IN. AND SMALLER)

1.8 FIELD TESTING

- A. Piping shall be pressure tested at a pressure of 1-1/2 times the maximum working pressure for not less than one hour with no leakage.
- B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories connected to the line which would be damaged by the test pressure shall be disconnected. Ends of branch lines disconnect points shall be plugged or capped as appropriate during the test procedure.
- C. Leaks shall be repaired to the satisfaction of the RESIDENT ENGINEER and the piping shall be re-tested until no leaks are found.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Pipe and fittings for welded joints shall comply with the requirements of latest edition of SSPWC and as indicated herein.

2.2 PIPE

- A. PVC pipe shall conform to ASTM D 1785 - Schedule 80, suitable for solvent weld joints unless indicated otherwise.

2.3 FITTINGS

- A. Fittings shall be socket fittings conforming to ASTM D 2467 - Schedule 80 unless indicated otherwise.

2.4 PIPE SUPPORTS

- A. Pipe supports shall conform to the requirements of Section 15020 - Pipe Supports and shall also be in compliance with the manufacturer's recommendations.

2.5 PERFORATED PIPE

SECTION 02645 – PVC PRESSURE PIPE (4 IN. AND SMALLER)

- B. Perforated pipe shall meet the requirements of Schedule 80 pipe in Section 2.2 above and shall have ¼-inch diameter circular perforations with a minimum opening of 0.22 square inches per linear foot of pipe. There shall be two rows of perforations. Perforations shall be evenly spaced along each row such that the center-to-center distance between perforations is not less than eight times the perforation diameter.

Rows shall be arranged in two equal groups at equal distance from the bottom on each side of the vertical centerline of the pipe. The lowermost rows of perforations shall be separated by an arc of not less than 60 degrees or more than 125 degrees. The uppermost rows of perforations shall be separated by an arc not to exceed 166 degrees. The spacing of rows between these limits shall be uniform.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPING

- A. General: PVC pipe shall be installed in accordance with the latest edition of SSPWC and the manufacturer's instructions for solvent weld joints.
- B. For exposed piping, pipe supports shall be provided in compliance with Section 15020 - Pipe Supports and as recommended by the pipe manufacturer.
- C. For buried piping, trenching configuration pipe zone material, backfill and compaction shall be performed in accordance with the manufacturer's instructions, and in compliance with Section 02200 - Earthwork.

3.2 PROTECTIVE COATING OF EXPOSED PVC PIPING

- A. Unless otherwise indicated, PVC piping exposed to sunlight shall be painted as specified in Section 09800 - Protective Coating.

3.3 PIPE IDENTIFICATION

- A. Piping identification shall be in compliance with Section 15030 - Pipe Identification Systems.
- B. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at the depth and location shown on the Drawings.

**** END OF SECTION ****

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide rubber gasketed polyvinyl chloride (PVC) pressure pipe greater than 4-inches in diameter, up to 12-inches in diameter, and all appurtenant work, complete in place.

1.2 RELATED SECTIONS

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

1. Section 10300 Submittals
2. Section 01730 Operation and Maintenance Information
3. Section 02200 Earthwork
4. Section 02630 Ductile Iron Pipe
6. Section 02666 Water Pipeline Testing and Disinfection
7. Section 09800 Protective Coating
8. Section 15030 Pipe Identification System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in. (75 mm through 1200 mm), for Water and Other Liquids
3. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. ANSI/AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

- | | |
|--------------------|--|
| | Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines |
| 5. ANSI/AWWA C600 | Installation of Ductile-Iron Water Mains and their Appurtenances |
| 6. ANSI/AWWA C605 | Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water |
| 7. ANSI/AWWA C900 | Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in. through 12-in. (100 mm through 300 mm), for Water Distribution |
| 8. AWWA Manual M23 | PVC Pipe - Design and Installation |

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
1. Shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances.
 2. Shoring and bracing drawings in accordance with Section 02200 - Earthwork.
 3. Manufacturer's technical data and installation instructions plus samples of all materials proposed for use on the Work. Samples shall be clearly marked to show the manufacturer's name and product identification.
 4. Test Reports from:
 - a. Hydrostatic proof testing
 - b. Sustained pressure testing
 - c. Burst strength testing
 5. Thrust block calculations and details.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The CONTRACTOR shall provide information in accordance with Section 01730 -Operations and Maintenance Information. This information shall include the manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the CONTRACT DOCUMENTS.

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

1.6 FACTORY INSPECTION AND TESTS

A. Tests: Except as modified herein, pipe shall be tested in accordance with the requirements of this Section and AWWA C900, as applicable. The manufacturer shall provide certification that the pipe has met all testing requirements and meet the specifications of AWWA C900 and AWWA C905.

PART 2 -- PRODUCTS

2.1 PIPE

- A. Pipe Design: PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 (4- through 12-inch diameter) and ANSI/AWWA C905 (14-inch through 18-inch diameter) and have a Dimension Ratio DR of 18. The pressure class or dimension ratio for pipe shall be shown on the Shop drawings along with the nominal pipe diameter.
- B. Pipe Dimensions: Dimensions for PVC pressure pipe shall conform to Table 1 of ANSI/AWWA C900 (4- through 12-inch diameter) and Table 1-B of ANSI/AWWA C905 (14-inch through 18-inch diameter) for cast iron pipe equivalent outside diameters.
- C. Pipe Marking: Pipe shall be marked in conformance with ANSI/AWWA C900 or ANSI/AWWA C905, as applicable.

2.2 FITTINGS

- A. Fittings for PVC pressure pipe shall be ductile iron and shall conform to the requirements of AWWA C110/A21.10, Class 350 and ANSI/AWWA C111/A21.11. Fittings shall be lined with cement mortar of double thickness as defined in ANSI/AWWA C104/A21.4. Buried ductile iron fittings shall be coated in accordance with the requirements of Section 09800 -Protective Coating.

2.3 JOINTS IN PIPE AND FITTINGS

- A. PVC pressure pipe shall have pipe ends that are either plain by elastomeric gasket bell or plain by plain. Each coupling for plain end by plain end pipe shall be furnished with two elastomeric gaskets. For pipe-to-pipe connections, solvent cement or PVC mechanical joints will not be accepted.
- B. Ductile iron fittings used with PVC pipe shall have mechanical joints and shall conform to the requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11. Solvent cement joints or push-on joints will not be allowed. Bolt holes in the flanges of the mechanical joint fitting shall straddle the vertical centerline of the fitting. Glands shall be made of ductile iron and shall be factory-stamped. Ductile iron from which the glands are cast shall have a minimum elongation of 5%. Bolts shall be tee heads made of high strength low-alloy steel – or ductile iron in accordance with ANSI/AWWA C111/A21.11.

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

Buried mechanical joint couplings and all harness-type restraints shall be coated with petrolatum/wax tape in accordance with Section 09800 - Protective Coating.

PART 3 – EXECUTION

3.1 GENERAL

- A. All laying, jointing, and testing for defects and for leakage shall be performed in the presence of the RESIDENT ENGINEER, and shall be subject to approval before acceptance.
- B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, ANSI/AWWA C600, ANSI/AWWA C605, SSPWC Subsection 306-8.5 and Supplement Amendments, and to the supplementary requirements or modifications specified herein. Wherever the requirements of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 PIPE STORAGE

- A. Storage: Pipe should be stored at the job site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe shall be stored in such a way as to prevent sagging or bending and shall be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Sections 02200 -Earthwork and as specified herein.

3.4 INSTALLATION OF PIPE

- A. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the RESIDENT ENGINEER may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.
- B. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one inch plus or minus. No tolerance is permitted on pipes designed for zero slope.

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

- C. Curved Alignments: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and this Section.
- D. Cutting and machining of the pipe shall only be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut by any method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- E. The CONTRACTOR shall install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the RESIDENT ENGINEER. Damaged interior and exterior surfaces shall be repaired to the satisfaction of the RESIDENT ENGINEER or a new undamaged pipe or appurtenance shall be provided.
- F. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The CONTRACTOR shall reinstall all affected pipe to its specified condition and grade.
- G. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- H. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface.
- I. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.
- J. Lay section of pipe with the bell end upgrade.

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

- K. Except for short runs which may be permitted by the RESIDENT ENGINEER, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10%. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
- L. Where indicated, concrete thrust blocks shall be provided.

3.5 INSTALLATION OF FITTINGS AND THRUST RESTRAINT

- A. Ductile iron fittings shall be installed using standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings or linings or coating. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to insure a sound and proper joint. Recoat damaged coatings.
- B. Ductile iron fittings for PVC pipe shall be restrained by the use of special harness arrangement from mechanical joint bell to PVC pipe bell or by concrete thrust blocks. PVC pipe harness shall circle entire pipe circumference and be designed for impart a uniform friction equally on the entire circumference of the bell end of pipe. Bolts, fasteners, tie-rods shall be manufactured of low alloy steel or stainless steel. All bolts, fasteners, and tie rods shall be wrapped completely with petrolatum wax tape after installation. Ductile iron components are also to be wrapped with polyethylene as described in Section 02630, Ductile Iron Pipe. Concrete thrust blocks, if used, shall bear against undisturbed soil.
- C. Ductile iron fittings for ductile iron pipe shall be restrained by the use of Mega-Lugs by Ebaa Iron, or equal.
- D. Mechanical harness for thrust restraint of buried fittings or thrust blocks shall be designed for the following pressures:

	Working (psi)	Test (psi)
725 Zone/Reservoir In-Out Piping	10	30
925 Zone/Pump Station Discharge Piping	100	150
Reservoir Drain Pump Discharge	20	50
Reservoir Overflow Piping	10	30

Concrete for thrust blocks shall be in accordance with SSPWC 201-1.1.2.

SECTION 02646 – PVC PRESSURE PIPE (Larger Than 4-Inch)

3.6 CONNECTIONS TO EXISTING SYSTEM

- A. All connections to existing water distribution mains of the 725 Zone will be performed by City forces. The CONTRACTOR shall expose the existing main at the connection point and install the new distribution main at the alignment and grade shown on the Drawings to within 10 lineal feet of the existing main. City forces will make a straight-in connection to the existing main. The CONTRACTOR shall furnish all required valves, piping, fittings, and appurtenances as shown on the Drawings for installation by City forces.
- B. The CONTRACTOR shall coordinate with the City, make all arrangements for the shutdown of the existing distribution main of the 925 Zone, and make the connection between the new distribution main and the existing water main. For connection requirements, refer to Section 01040 – Coordination.

3.7 FIELD TESTING AND DISINFECTION

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

3.8 SITE RESTORATION

- A. The CONTRACTOR shall backfill and compact soil in accordance with Section 02200 -Earthwork.
- B. The CONTRACTOR shall place subgrade and base materials in accordance with Section 02200 - Earthwork.
- C. The CONTRACTOR shall replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in the latest edition of SSPWC
- D. The CONTRACTOR shall provide hydro-seeding or mulching in areas indicated. The surface shall be graded as indicated on the Drawings with a minimum of 4 inches of topsoil. Hydro-seeding shall be performed according to Section 02900 - Landscaping.

3.9 MARKING TAPE INSTALLATION

- A. Continuous plastic marking tape and metallic locator tape shall be installed in accordance with the requirements of Section 02200 - Earthwork along the pipeline at a depth of 6 to 12 inches above top of pipeline.

**** END OF SECTION ****

SECTION 02650 – STEEL PIPE, LINED AND COATED

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide steel pipe, lined and coated as specified herein, complete, in accordance with the CONTRACT DOCUMENTS.
- B. The Work requires that one pipe manufacturer accept responsibility for furnishing the coated and lined pipe without altering or modifying the CONTRACTOR's responsibilities under the CONTRACT DOCUMENTS.
- C. Steel pipe shall be cement mortar lined and coated. Where cathodic protection is used, the coating shall consist of a cold-applied tape and a cementer mortar coating. Lining and coating of steel pipe shall conform to the requirements of Section 09800 – Protective Coating.

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
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operation and Maintenance Information
 - 3. Section 02200 Earthwork
 - 4. Section 02666 Water Pipeline Testing and Disinfection
 - 5. Section 03300 Cast-in-Place Concrete
 - 6. Section 09800 Protective Coating
 - 7. Section 15000 Piping Components
 - 8. Section 15020 Pipe Supports
 - 9. Section 16640 Cathodic Protection System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. ANSI/ASTM A 20 Specification for General Requirements for Steel Plates for Pressure Vessels

SECTION 02650 – STEEL PIPE, LINED AND COATED

2. ANSI/ASTM A 36 Specification for Carbon Structural Steel
3. ANSI/ASTM A 283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
4. ANSI/ASTM A 370 Test Methods and Definitions for Mechanical Testing of Steel Products
5. ANSI/ASTM A 516 Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
6. ANSI/ASTM A 570 Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
7. ANSI/ASTM A 572 Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
8. ANSI/ASTM C150 Specification for Portland Cement
9. ANSI/ASTM E 165 Practice for Liquid Penetrant Inspection Method
10. ANSI/AWWA C200 Steel Water Pipe - 6 in. (150 mm) and Larger
11. ANSI/AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
12. ANSI/AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied
13. ANSI/AWWA C206 Field Welding of Steel Water Pipe
14. ANSI/AWWA C208 Dimensions for Fabricated Steel Water Pipe Fittings
15. ANSI/AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
16. ANSI/AWWA C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
17. ANSI/AWWA C214 Tape Coating Systems for the Exterior of the Steel Water Pipelines
18. ANSI/AWWA C215 Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines

SECTION 02650 – STEEL PIPE, LINED AND COATED

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| 19. ANSI/AWWA C602 | Cement-Mortar Lining of Water Pipelines In Place - 4-in. (100 mm) and Larger |
| 20. ANSI/AWS D1.1 | Structural Welding Code - Steel |
| 21. API Standard 1104 | Welding Pipelines and Related Structures |
| 22. AWWA M11 | Steel Pipe - A Guide for Design and Installation |
| 23. ASME | Boiler and Pressure Vessel Code |
| 24. ASTM A234 | Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures |

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300 - Submittals, Section 15000 - Piping Components, and the following supplemental requirements as applicable. Submittals for steel pipe and specials shall be coordinated between the sections.

1. Fabrication Information:

- a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product.
- b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.
- c. Pipe Fabricator's Credentials: Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe in this project. Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project. To demonstrate ability to meet the schedule requirements of this project, submit project descriptions and manufacturing/fabrication schedules for other currently contracted pipe projects at the

SECTION 02650 – STEEL PIPE, LINED AND COATED

Fabricator's plant. The manufacturing/fabrication schedule for the pipe in this project shall be identified on schedule submittals per the latest edition of SSPWC.

- d. Manufacturer's written Quality Assurance/Control Program.
2. Materials: Material lists and steel reinforcement schedules which include and describe all materials to be used. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Specifications.
 3. Line Layout Information:
 - a. Line layout and marking diagrams compatible with the requirements of AWWA M11 and which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and centerline elevation at all changes in grade or horizontal alignment; the station and centerline elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment. The location of all metered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.
 - b. Dimensional drawings of all valves, fittings, and appurtenances as specified in Section 15000 - Piping Components.
 - c. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.
 - d. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.
 4. Welding Information:
 - a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications numbers shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.

SECTION 02650 – STEEL PIPE, LINED AND COATED

- b. Written welding procedures for shop and field welds, including Welding Procedure Specifications and Procedure Qualification Records.
 - c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.
 - d. Current welder performance qualifications shall be submitted for each welder used before the welder performs any Work either in the shop or field. Qualification testing shall be as specified in Paragraph 1.6H in this Section.
 - e. Submit the credentials of the CONTRACTOR's certified welding inspectors and quality control specialist for review before starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society QC-1 Certification.
 - f. Submit all nondestructive testing data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic, magnetic particle, dye penetrant examination, ultrasonic, or air test examination methods specified. Test data shall be reviewed and signed by the welding inspector(s).
 - g. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.
 - h. Submit a welding map showing the sequence of welds for all field welds.
 - i. Submit a written weld repair procedure for each type of shop and field weld proposed for use on the Project.
 - j. Submit a written rod control procedure for shop and field operations demonstrating how the CONTRACTOR intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the CONTRACTOR intends to ensure that the proper rods are used for each weld.
5. Handling and Support Information: Detail drawings indicating the type, number and other pertinent details of the slings, strutting and other methods proposed for pipe support and handling during manufacturing, transport, and installation. Calculations supporting the handling and support system design shall be submitted. Drawings and calculations shall be sealed by a registered professional engineer.

SECTION 02650 – STEEL PIPE, LINED AND COATED

6. Control of Temperature Stresses:
 - a. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation before starting of any field welding.
 - b. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures.
 - c. Submit plan for monitoring pipeline temperatures.
- B. Certifications: Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C206, and C602, respectively, and the following supplemental requirements:
 1. Compliance with the additional requirements included in the CONSTRUCTION DOCUMENTS.
 2. Physical and chemical properties of all steel.
 3. Hydrostatic test reports.
 4. Results of production weld tests.
 5. Sand, cement, and mortar tests.
 6. Rubber gasket tests.
 7. All materials are NSF approved for use with potable water.
 8. Pipe temperature complies with Specifications before pouring pipe zone material, and before and during welding temperature control joints (including supporting data).
 9. All welds were performed in conformance with these documents.
- C. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the CONTRACTOR at no increased cost to the OWNER.

1.5 OPERATION AND MEINTENANCE INFORMATION

- A. The following item shall be included as required in Section 01730 – Operations and Maintenance Information.

SECTION 02650 – STEEL PIPE, LINED AND COATED

1. Certifications: The CONTRACTOR shall furnish a certification stating that all pipe, special fittings, and other products or materials furnished under this Section comply with ANSI/AWWA C200, C203, and C205. Additionally, the CONTRACTOR shall furnish certified reports of the following tests:
 - a. Physical and chemical properties of all steel.
 - b. Hydrostatic test reports.
 - c. Results of production weld tests.
- B. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.6 FACTORY INSPECTION, TESTS AND WELDING REQUIREMENTS

- A. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, and C602, as applicable, as supplemented by the requirements herein. Notify the RESIDENT ENGINEER in writing not less than 14 calendar days before the start of any phase of the pipe manufacture, welding, lining, coating, testing, or field operations. The cost of factory testing shall be paid by the CONTRACTOR.
- B. Testing: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206, and C602, as applicable.
 1. After the joint configuration is completed and before lining with cement-mortar, if applicable, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 80 percent of the yield strength of the pipe steel. Test pressure shall be maintained for a minimum of 5 minutes. Any leaks shall be repaired and the pipe retested.
 2. Production weld tests as required in ANSI/AWWA C200, except weld tests shall be conducted on each 5000 feet of production welds at a minimum, and at least one set of tests per operator per work shift shall be performed.
- C. Cost of Testing: Perform said material tests at no additional cost to the OWNER. The RESIDENT ENGINEER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the RESIDENT ENGINEER.
- D. Samples: In addition to those tests specifically required, the RESIDENT ENGINEER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

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- E. Welding Procedure Specifications: All welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (PVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for all welds, both shop and field. Welds qualified per the ASME PVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.

- D. Welder Performance Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified by the CONTRACTOR under the provisions of ASME PVC for shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.

- E. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as specified below. Testing shall include submitting written documentation of procedures in accordance with Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
 - 1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the RESIDENT ENGINEER, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
 - 2. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.
 - 3. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.
 - 4. All Welds: CONTRACTOR's certified welding inspector shall 100 percent visually examine all welds as a minimum.
 - 5. In addition to weld tests hereinbefore specified, doubler pads shall be air tested as stated in AWWA C206

- F. Pipe Manufacturer/Fabricator: The manufacturer or fabricator of the pipe shall be experienced in fabricating pipe of similar diameters and wall thicknesses required for the Work and shall have the manufacturing capability to meet the schedule requirements of this project. This experience requirement shall apply to the fabrication plant facility and responsible personnel, not to the firm which owns the facility or employs the personnel.

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1.7 FIELD TESTING

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

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, and C602, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded joints, as indicated in the CONTRACT DOCUMENTS. For pipe larger than 24-inches in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24-inches in diameter and smaller may be provided in standard outside diameters.
- B. Markings: Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word “top” shall be painted or marked on the outside top spigot of each pipe section.
- C. Handling and Storage: The pipe shall be handled by use of wide slings, padded cradles, or other devices, designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3-inches in diameter. The ends of all pipe shall be securely bulkheaded or otherwise sealed during transport to the jobsite. All pipe handling equipment and methods shall be acceptable to the RESIDENT ENGINEER.
- D. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the OWNER.
- E. Strutting: Adequate strutting (stulling) shall be provided on all specials, fittings, and straight pipe so as to avoid damage or distortion to the pipe and fittings during handling, storage, hauling, and installation. The following requirements shall apply:
 - 1. The strutting shall be placed as soon as practicable after the pipe is fabricated or the mortar lining has been applied and shall remain in place

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while the pipe is loaded, transported, unloaded, installed and backfilled at the job site.

2. The strutting materials, size and spacing shall be the responsibility of the CONTRACTOR and shall be adequate to prevent deflection and support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment. One strut shall be placed vertical oriented with the top of pipe. One set of struts shall be set 2-feet from each end of each pipe section and at a maximum interval of 15-feet in-between.
 3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.
- F. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. The CONTRACTOR shall select lengths to accommodate the operation.
- G. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- H. Cathodic Protection System: Cathodic protection systems shall be applied to pipelines in accordance with Section 16640 – Cathodic Protection System.
- I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of correction pieces and closure assemblies shall be shown on the pipe layout diagrams and shall be subject to the RESIDENT ENGINEER's review. Any change in location or number of said items shall be approved by the RESIDENT ENGINEER.

2.2 MATERIALS

- A. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II or V, per ASTM C 150. Fly ash or pozzolan shall not be used as a cement replacement.
- B. Steel Pipe and Specials: Minimum yield point of steel shall be 38,000 psi and steel shall be as specified below.
1. Steel coils shall be made from the continuous cast process or continuous cast slabs, fully killed, fine-grain practice conforming to the physical and chemical characteristics of ASTM A 516 Grade 70. For sheet steel, the maximum allowable thickness variation shall be 0.010-inch under or over the nominal thickness.

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2. Steel plate shall be fully killed, conform to ASTM A 20, and be manufactured to fine-grain practice conforming to the physical and chemical characteristics of ASTM A 516 Grade 70. For plate steel, the maximum allowable thickness variation shall be 0.010-inch under or over the nominal thickness.
- C. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. Pipe sections shall be fabricated by either of the following methods:
1. Pipe sections may be spirally welded or fabricated from short cylindrical courses joined circumferentially by complete penetration butt joint welds with not more than two longitudinal seams per course. Longitudinal seams shall be staggered on both sides of the pipe.
 2. Pipe sections may be rolled or pressed from no more than three sheets the full length of the pipe and welded with no more than three longitudinal seams. Patching inserts, overlays, or pounding out of dents will not be permitted. Repair of notches or laminations on second ends will not be permitted. Damaged ends shall be removed as a cylinder and the section end properly prepared. Distorted or flattened lengths shall be rejected. A buckled section shall be replaced as a cylinder.
- D. Charpy Tests:
1. General. Steel used in production manufacturing of pipe and specials shall be tested for notch toughness using Charpy V-Notch tests per ASTM A 370. The test acceptance for full size specimens (10 mm by 10 mm size) shall be 25 foot-pounds at a test temperature of 30 degrees F; tests shall include three impact specimens and shall be conducted in the direction transverse to the final direction of rolling. Subsize specimens taken from steel less than 7/16-inch thickness shall be tested for acceptance at reduced values per Table 6 of ASTM A 370.
 2. Plate. Charpy tests shall be conducted on each plate as required in ASTM A 20.
 3. Coils. Charpy tests shall be conducted on the first 500 tons of steel by testing each coil as follows:
 - a. Tests shall include representative sampling of all steel thicknesses required for the Work.
 - b. Each coil shall be tested by taking coupons from the outer, middle, and inner wrap of the coil. Middle coil coupons may be taken from the ends of full-length pipes that are closest to the middle of the coil.

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- c. Coils that do not meet the above Charpy acceptance criteria shall not be used in production of pipe.
- d. After the initial 500 tons, conduct one test per heat of coil on the outer wrap only.

2.3 SPECIALS AND FITTINGS

- A. Unless otherwise required, all specials shall be in accordance with Section 02653 – Fabricated Steel Pipe Specials and shall conform to the dimensions of ANSI/AWWA C208. Pipe fittings shall conform to the requirements of Section 15000 – Piping Components.

2.4 DESIGN OF PIPE

- A. General: Steel pipe shall be manufactured, tested, inspected, and marked according to applicable requirements of this Section and, except as hereinafter modified, shall conform to ANSI/AWWA C200.
- B. Pipe Dimensions: Pipe shall be of the diameter and wall thickness shown on the Drawings. Unless indicated otherwise, minimum wall thickness shall be 1/4-inch.
- C. Specials Dimensions: Pipe specials shall be of the diameter and wall thickness indicated on the Drawings, or as specified in Section 02653 – Fabricated Steel Pipe Specials.
- D. Joint Design: Unless otherwise shown, the standard field joint for steel pipe shall be a double-welded (fully circumferential) lap joint. Mechanically coupled, or flanged joints shall be provided where indicated on the Drawings. Butt-strap joints shall be used only where required for closures or where indicated. The joints furnished shall have the same or higher pressure rating as the abutting pipe. Air test tapped holes shall be provided for each double welded lap joint as defined in Section 02666 – Water Pipeline Testing and Disinfection. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the RESIDENT ENGINEER, bell ends shall be formed by an expanding press or by the pipe being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. The ends shall not be rolled. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.
- E. Lining and Coating: Lining and coating of steel pipe shall conform to the requirements of Section 09800 - Protective Coating. Field lining will only be allowed where specifically indicated on the Drawings. Shop-applied interior

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linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the RESIDENT ENGINEER. All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended liquid epoxy finish coating as specified in Section 09800 - Protective Coating.

- F. Joint Stops: The pipe manufacturer shall tack weld four metal tabs at equal intervals around the inside circumference of the bell ends of all welded pipe to indicate the location at which the spigot end has reached maximum penetration into the bell. These tabs shall be removed before welding the inside of the joint.
- G. Temperature Control Lap Joint: A special longer bell end (temperature control lap joint) shall be provided at a maximum spacing of 300 feet to account for movement of the installed pipe due to temperature changes. The pipe manufacturer shall determine the length required for the longer bell as defined by the CONTRACTOR's pipe laying procedures and the location of the special bell.
- H. Shop Fit Test:
 - 1. To ensure that joints may be fully assembled and that excessive annular space between spigots and bells does not exist, and that the pipe meets the requirements of AWWA C200, the pipe fabricator shall perform a shop fit test on a minimum of five joints. The joints to be tested shall be selected by the RESIDENT ENGINEER based on pipe measurements.
 - 2. The shop fit test shall join the pipe ends in the shop with the proposed adjacent pipe end.
 - 3. Record the actual annular space, with the data to include as a minimum:
 - a. Maximum space at any point.
 - b. Minimum space at any point.
 - c. Space at 90-degree intervals--top, bottom, and spring line on both sides.
 - 4. The pipe ends shall be match marked after shop assembly.

2.5 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Except as otherwise required, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining

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machines shall be of a type that has been used successfully for similar work and shall be approved by the RESIDENT ENGINEER. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the OWNER.

- B. Lining Thickness: The minimum lining thickness shall be 3/4-inch.
- C. Lining Holdback: The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defects: Defective linings, as determined by the RESIDENT ENGINEER, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe, specials, or fittings with cracks wider than 1/16-inch shall be rejected.
- E. Repairs: The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for shop or machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.
- F. Materials: Unless otherwise indicated, all steel pipe shall be mortar-lined. The materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and the following supplementary requirements:
 - 1. Pozzolanic material shall not be used in the mortar mix.
 - 2. Admixtures shall contain no calcium chloride.
 - 3. The minimum lining thickness shall be as indicated for shop-applied cement-mortar lining and finished inside diameter after lining shall be as indicated.
 - 4. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe, specials, or fittings with mortar cracks wider than 1/16-inch shall be rejected.
 - 5. Field applied mortar lining shall meet the requirements of this Subparagraph F.

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- G. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement-mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING OF PIPE

- A. Exterior Coating of Exposed Piping: Exposed steel pipe shall be coated as specified in Section 09800 - Protective Coating.
- B. Coating of Buried Piping: Buried steel pipe shall be coated with a tape and cement-mortar coating (rock shield) as specified in Section 09800 - Protective Coating. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. The welded wire fabric shall be securely fastened to the pipe with welded clips or strips of steel. The wire spaced 2-inches on centers shall extend circumferentially around the pipe. The ends of reinforcement strips shall be lapped 4-inches and the free ends tied or looped to assure continuity of the reinforcement.
- C. Coating of Buried Pipe or Fittings Passing through Structure Walls: Unless otherwise indicated, exterior surfaces of buried pipe or fittings passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of the applicable pipe or fitting.
- D. Joint Diapers: Joint diapers shall be provided for buried pipe with rigid mortar protective coat as described herein. Grout bands or heavy-duty diapers for protection of joints on cement-mortar coated pipe shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids alkalis and solvents, and shall be Dow Chemical Company, Ethafoam 222, or equal. The fabric backing of joint diapers shall be cut and sewn into strips wide enough to overlap shop-coated areas by 4-inches on either side. Strips shall have slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips wide enough to match the uncoated field joint area and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

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2.7 PIPE APPURTENANCES

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

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

- A. **Handling and Storage:** All pipe, fittings, and specials shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the RESIDENT ENGINEER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the requirements stated below. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks or other damage that may be harmful as determined by the RESIDENT ENGINEER. Such damaged lining and coating/interior and exterior surfaces, shall be repaired to the satisfaction of the RESIDENT ENGINEER, or a new undamaged pipe shall be furnished.
- B. **Repair:** All pipe damaged before Substantial Completion shall be repaired or replaced by the CONTRACTOR at no additional cost to the OWNER.
- C. **Inspection:** Inspect each pipe and fitting to ensure that there are no damaged portions of the pipe. Remove or smooth out any burrs, gouges, weld splatter or other small defects before laying the pipe.
- D. **Foreign Substances:** Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.
- E. **Lifting Points:** Lifting points shall be no closer than the 1/3 and 2/3 points along the length of the section. CONTRACTOR shall be responsible for selecting lifting points that when used, do not result in damage to the pipe.
- F. **Excavation:** Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- G. **Alignment and Grade Changes:** Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the RESIDENT ENGINEER may

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change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of beveled joint rings, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer or the amount that results in more than a 1/8-inch gap at the weld location, whichever is less. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.

- H. Laying Direction: Except for short runs which may be permitted by the RESIDENT ENGINEER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.

- I. Struts: Pipe struts shall be left in place until backfilling operations have been completed for pipe 42-inches in diameter and larger. Struts in pipe smaller than 42-inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed by the CONTRACTOR and shall remain the property of the CONTRACTOR. Struts shall not be removed with a torch or any other method that may damage the pipe lining or coating. The parent pipe material shall not be nicked, gouged, or damaged during strut removal. All repairs of gouges or nicks in the parent material shall be made using 3/32-inch maximum diameter E-6010 welding electrodes with a maximum heat input of 5.6 kJ per inch. Tack welds, stull metal, weld splatter, slag, and burrs that remain attached to the parent metal surface after cutting shall be ground to within 1/32-inch of the parent metal. Grinding shall not penetrate the parent metal. The CONTRACTOR shall notify the RESIDENT ENGINEER before grinding. Following grinding, all pipe surfaces at the tack weld shall be visually inspected for defects. All defects deeper than 1/16-inch shall be repaired by welding in accordance with ANSI/AWSD.1.1 and AWWA/ANSI C206. All inspection work shall be performed by a certified welding inspector.

- J. Bulkheads:
 - 1. Before shipment of pipe with cement mortar lining the lining shall be wetted then a suitable bulkhead shall be attached to each end of the pipe section. This bulkhead shall remain in place and in good condition through transit to the Project.

 - 2. During construction the openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe.

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Introduce water into the pipe as needed to keep the mortar moist where moisture has been lost due to damaged bulkheads.

- K. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs before testing and disinfecting the completed pipeline.
- L. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the laying diagram and the following requirements:
 - 1. Each section of pipe having a nominal diameter less than 48-inches shall be laid to line and grade, within plus or minus 2-inches horizontal deviation and plus or minus 1 inch vertical deviation.
 - 2. Each section of pipe having nominal diameter 48-inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
 - 3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.
 - 4. Pipe deflection, after backfill but before installation of field-applied cement mortar lining, if applied, shall not exceed 2.25 percent for flexible coated pipe and 1.5 percent for cement mortar coated pipe. Deflection shall be measured by the difference in vertical inside diameter in the installed pipe and the manufactured pipe.
 - 5. Pipe not conforming to these criteria or which otherwise impact the ability to complete the Work shall be removed and reinstalled in full conformance with the CONTRACT DOCUMENTS at no additional cost to the OWNER.
- M. Protection of Pipe: At locations where the CONTRACTOR proposes to cross the installed pipeline with heavy equipment, precautions as approved by the RESIDENT ENGINEER shall be taken to protect the pipe from damage. Acceptable precautions include: backfilling the pipe trench as necessary to protect the pipe, concrete encasing the pipe, and placing steel plating over the pipe. Any damage to the pipe caused by the CONTRACTOR's operation or his equipment shall be repaired at no additional cost to the OWNER.

3.2 WELDED JOINTS

- A. Welding Procedures, Welding Qualifications, and Testing:

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1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. All qualifications shall be in accordance with all-position pipe tests as defined in Section 5 of AWS D1.1.
2. For field welding, the welder qualification testing shall be performed at the site. Previous qualifications will not be accepted. The CONTRACTOR shall obtain the services of an independent testing laboratory to perform the welder qualification onsite. Copies of all test data and certifications shall be provided to the RESIDENT ENGINEER. All costs for welder qualification testing shall be at no increased cost to the OWNER.
3. Upon completion of each field-welded joint, the welding operator shall mark his regularly assigned identification number and the last two numbers of the year in which the Work was completed, or the CONTRACTOR may have a records system that traces a welder's work completion to a specific joint. Steel stamping directly on piping will not be permitted unless "low stress" die stamps, such as interrupted dot or round nose types, are used.
4. All field lap welds will be inspected by magnetic particle or dye penetration methods. Field butt welds will be inspected in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.
5. Double welded lap joints shall be air tested in the presence of the RESIDENT ENGINEER in accordance with Section 02666 - Water Pipeline Testing and Disinfection. Repairs and retesting shall be required if any loss of pressure occurs.
6. The CONTRACTOR shall inform the RESIDENT ENGINEER before completed weld joints are to be backfilled so that the joint may be inspected. The CONTRACTOR shall assume all costs of exposing backfilled joints for inspection when backfilling preceded the inspection.
7. Personnel performing visual inspection of welds shall be qualified and currently certified as Certified Welding Inspectors in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to the requirements of SNT-TC-1A.
8. The RESIDENT ENGINEER may also order nondestructive testing by an independent testing laboratory in addition to any testing specified herein. Except as otherwise specified herein, all costs for the independent testing laboratory to inspect and test field welds will be paid for by the OWNER. If the weld is defective, the inspection costs shall be paid for by the

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CONTRACTOR. Defective welds shall be repaired and retested at the CONTRACTOR's expense.

9. Test reports of all laboratory tests shall be submitted as provided in the quality control section.
- B. Space for Inspection: Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
- C. Lap Welded Joints: During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap as shown on the Drawings.
- D. Butt Straps: Where used or required, shall be as shown on the Drawings.
- E. Welding: After the pipe and pipe joint are properly positioned in the trench, the CONTRACTOR shall weld and provide external joint protection for all joints except the special temperature control lap joint hereinafter specified. The length of pipe between special temperature control joints shall be backfilled to at least one foot above the top of the pipe as hereinafter specified. The special temperature control joints shall be welded after the pipe is backfilled to at least one foot above the top of the pipe for the full distance between the temperature control joints upstream and downstream. Joint protection shall be provided for special temperature control joints after completion of the joint welds and tests as specified. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the special temperature control joint.
- F. Shading: To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours before the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.
- G. Welding: Before backfilling or beginning the welding procedure, any tack welds or joint stops used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, all dirt, slag, and flux shall be removed before the succeeding bead is applied.
- H. Testing of Joints: The pipeline joints shall be tested as specified herein and in Section 02666 - Water Pipeline Testing and Disinfection.

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- I. Coating Joint Spaces: Following tests of the joint, the exterior joint spaces shall be coated in accordance with the Specifications after which backfilling may be completed.
- J. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.
- K. Repair of Welds: All welds that are defective shall be repaired by the CONTRACTOR to meet the requirements of this Section at no additional cost to the OWNER. Defects in welds or defective welds shall be removed, and that section of the joint shall then be rewelded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

- A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The grout for joint coating and lining shall be cement grout in accordance with Section 03315 - Grout, except that the composition shall be one part cement to two parts sand and sufficient water for dry-pack consistency.
- B. Coating of Joints for Cement-Mortar Coated Pipe: After the completion of joint testing and cleaning, all joints shall be coated as follows:
 - 1. After the pipe has been laid, the joint welded and cleaned, and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with grout formed by the use of a diaper. The grout space before filling shall be flushed with water so that the surface of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than three joints of the pipe being laid.

SECTION 02650 – STEEL PIPE, LINED AND COATED

2. The grout band (diaper) shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam, as applicable. The grout band shall remain in position on the pipe joint.
- C. Coating of Joints for Tape and Cement-Mortar Coated Pipe: After the pipe has been laid, the joint welded and cleaned, and after sufficient backfill has been placed between the joints to hold the pipe securely in place, joints shall be tape wrapped in accordance with ANSI/AWWA C209. Upon completion of the tape wrapping, the tape shall be protected with mortar coating as described in Paragraph B above.
- D. Joint Lining: After the backfill has been completed to final grade, the interior joint recess of shop-lined pipe shall be filled with grout, tightly packed into the joint recess and troweled flush with the interior surface. All excess shall be removed. At no point shall there be an indentation or projection of the grout exceeding 1/16-inch. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout containing one part cement to two parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.

3.4 FIELD-APPLIED CEMENT-MORTAR LINING

- A. Unless otherwise indicated, the CONTRACTOR shall construct the cement-mortar lining in-place after the pipeline is backfilled to approximate finished grade. The application of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602.
 1. The lining machine shall be of a type that has been used successfully for a similar size of pipe. Perform all Work in a thorough and workmanlike manner by trained personnel, under the supervision of experienced personnel skilled in machine application of cement-mortar lining to pipelines of size comparable to this Work.
 2. Curing of the in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602, except the CONTRACTOR shall be responsible for curing and maintaining the lining until final acceptance by the RESIDENT ENGINEER. Provide a system to maintain a suitably moist environment within the pipe to properly cure and maintain the lining. Provide additional protective devices as required to ensure that the airtight covers, which maintain a moist condition in the pipeline, are not damaged.

SECTION 02650 – STEEL PIPE, LINED AND COATED

3. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever the length measured along the pipe centerline is greater than 5 feet; otherwise defective areas may be replaced by hand.

3.5 INSTALLATION AND PROTECTION OF APPURTENANCES

- A. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared before installation. Adjust all stem packing and operate each valve before installation to insure proper operation. Valves (body and seat) shall not be subjected to test pressures greater than manufacturer's recommendation. In some cases this may require an increase in the valve pressure class. Valves shall be installed so that the valve stems are plumb and in the location indicated. Buried valves shall be coated in accordance with Section 09800 - Protective Coating.
- B. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only. Buried flanges shall be coated in accordance with Section 09800 - Protective Coating.
- C. Installation of Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only. Buried flexible couplings shall be coated in accordance with Section 09800 - Protective Coating.
- D. Protection of Appurtenances: Unless specified otherwise, buried appurtenances shall be coated with a minimum thickness of 1-1/4-inch of cement mortar having one part cement to not more than two parts plaster sand. Unless specified otherwise, where the exterior surface of the adjacent pipeline is protected by a liquid epoxy protective coating, appurtenances shall also be coated with liquid epoxy as specified in Paragraph 2.6.D.

SECTION 02650 – STEEL PIPE, LINED AND COATED

3.6 CORROSION CONTROL

- A. Cathodic Protection: Corrosion mitigation and testing materials shall be provided where indicated and in accordance with Section 16640 - Cathodic Protection System.

3.7 SITE RESTORATION

- A. Backfill and compaction shall be performed in accordance with Section 02200 - Earthwork.
- B. The CONTRACTOR shall place subgrade and base materials in accordance with Section 02200 - Earthwork.
- C. The CONTRACTOR shall replace damaged pavement, curbs, gutters, and sidewalks, shrubs, and trees as indicated in the latest edition of SSPWC.
- D. The CONTRACTOR shall provide landscaping as required on the CONTRACT DOCUMENTS.

****END OF SECTION****

SECTION 02653 – FABRICATED STEEL PIPE SPECIALS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide fabricated steel pipe specials and connections to new and existing piping.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 01730 Operation and Maintenance Information
3. Section 02200 Earthwork
4. Section 02650 Steel Pipe, Lined and Coated
5. Section 02666 Water Pipeline Testing and Disinfection
6. Section 09800 Protective Coating
7. Section 15000 Piping Components
8. Section 16640 Cathodic Protection System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:

1. California Plumbing Code

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

- C. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

1. ANSI B16.3 Malleable Iron Threaded Fittings, Class 150 and 300
2. ANSI B16.11 Forged Steel Fittings, Socket-Welding and Threaded
3. ASTM A 36 Carbon Structural Steel

SECTION 02653 – FABRICATED STEEL PIPE SPECIALS

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| 4. ASTM A 47 | Ferritic Malleable Iron Castings |
| 5. ASTM A 53 | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| 6. ASTM A 105 | Forgings, Carbon Steel, for Piping Components |
| 7. ASTM A 106 | Seamless Carbon Steel Pipe for High Temperature Service |
| 8. ASTM A 197 | Cupola Malleable Iron |
| 9. ASTM A 234 | Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures. |
| 10. ASTM A 283 | Low and Intermediate Tensile Strength Carbon Steel Plates |
| 11. ASTM A 536 | Ductile Iron Castings |
| 12. ASTM A 570 | Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality |
| 13. ASTM A 572 | High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| 14. ASTM D 16 | Terminology Relating to Paint, Varnish, Lacquer, and Related Products |
| 15. ASTM D 471 | Test Method for Rubber Property-Effect of Liquids |
| 16. ASTM D 543 | Test Method for Resistance of Plastics to Chemical Reagents |
| 17. ASTM D 2240 | Test Method for Rubber Property-Durometer Hardness |
| 18. ASTM D 4060 | Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser |
| 19. ASTM E 96 | Test Method for Water Vapor Transmission of Materials |
| 20. ANSI/AWWA C200 | Steel Water Pipe - 6 in. (150 mm) and Larger |
| 21. ANSI/AWWA C203 | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied |

SECTION 02653 – FABRICATED STEEL PIPE SPECIALS

22. ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied
23. ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
24. ANSI/AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
25. ANSI/AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
26. ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and their Appurtenances
27. ANSI/AWWA C602	Cement-Mortar Lining of Water Pipelines in Place - 4-in. (100 mm) and Larger
28. AWWA M11	Steel Pipe - A Guide for Design and Installation
29. SSPC	Steel Structures Painting Council Specifications

1.4 CONTRACTOR SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 – Submittals and Section 15000 - Piping Components:
 - 1. Certificates of Compliance with the indicated standards.
 - 2. Detailed drawings showing layout and connections.
 - 3. Calculations and drawings for anchorage (if any).

1.5 FACTORY INSPECTION AND TESTING

- A. Product Testing: Steel pipe specials shall be tested at the factory for compliance with the indicated standards.
- B. Inspection: Linings and coatings, except for cement mortar, shall be inspected electrically for continuity at the place of application.

PART 2 -- PRODUCTS

2.1 GENERAL

SECTION 02653 – FABRICATED STEEL PIPE SPECIALS

- A. Fabricated steel pipe and joints shall comply with ANSI/AWWA C200 and SSPWC Subsection 209-2.2.

2.2 PIPE MATERIALS

- A. Steel Pipe: Steel pipe shall comply with SSPWC Subsection 209-2 and ANSI/AWWA C200.
- B. Steel Pipe Fabricated to Meet Requirements of ANSI/AWWA C200: Fabricated pipe shall comply with the requirements of SSPWC Subsection 209-2.2, and City of San Diego Supplement Amendments. Wall thicknesses shall comply with SSPWC Subsection 209-2.2.

2.3 FITTINGS

- A. Fittings shall comply with the following:
 - 1. Forged Steel Fittings: ASTM A234, ASTM A 105 or ANSI B16.11.
 - 2. Fabricated Steel Fittings: ANSI/AWWA C208.
 - 3. Grooved Fittings: Full-flow cast fittings, or segmentally welded fittings with grooves or shoulders designed and fabricated for standard grooved-end piping.
 - 4. Cast Fittings: Ductile iron conforming to ASTM A 536 or malleable iron conforming to ASTM A 47.

2.4 PIPE LINING

- A. Cement-Mortar Lining: Steel pipe specials shall be centrifugally lined with cement mortar having a minimum thickness of $\frac{3}{4}$ inch and complying with ANSI/AWWA C205. If the special cannot be lined centrifugally, it shall be lined by hand in compliance with ANSI/AWWA C602. Fittings and specials larger than 24-inches, not fabricated from centrifugally formed straight sections, shall require 2-inch by 4-inch WO.5 x WO.5 gage self-furring wire mesh reinforcement for hand-applied lining. The wire mesh shall be positioned approximately in the center of the lining. The wires spaced 2-inches on centers shall run circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 4-inches and the free ends tied or looped to assure continuity.
- B. Surface Preparation: Surfaces of pipe specials shall be prepared in accordance with SSPC-SP 10 for Near White Blast Cleaning, and the lining shall be applied as recommended by the manufacturer.

SECTION 02653 – FABRICATED STEEL PIPE SPECIALS

2.5 EXTERIOR COATING OF PIPE SPECIALS

- A. Exterior Coating of Exposed Pipe Specials: Exposed pipe specials shall be coated as specified in Section 09800 – Protective Coating.
- B. Coating of Buried Pipe Specials: Buried steel pipe specials shall be coated with a tape and cement mortar coating (rock shield) as specified in Section 09800 – Protective Coating. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. The welded wire fabric shall be securely fastened to the pipe special with welded clips or strips of steel. The wire spaced 2-inches on centers shall extend circumferentially around the pipe special. The ends of reinforcement strips shall be lapped 4-inches and the free ends tied or looped to assure continuity of the reinforcement.
- C. Coating of Buried Pipe Specials Passing through Structure Walls: Unless otherwise indicated, exterior surfaces of buried pipe specials passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of the applicable pipe special.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Steel pipe specials shall be installed in accordance with AWWA M11, Chapter 16 and Section 02650 – Steel Pipe, Lined and Coated.
- B. Field applied pipe lining and coatings shall comply with ANSI/AWWA C205, ANSI/AWWA C209, SSPWC Subsection 306-8.3, and Section 02650 – Steel Pipe, Lined and Coated.

3.2 TESTING

- A. Hydrostatic testing and disinfection shall comply with Section 02666 - Water Pipeline Testing and Disinfection.
- B. Coatings shall be inspected electrically immediately before the special is placed in the trench, following the same requirements for factory inspection procedure and voltage indicated above the protective material. Holidays shall be repaired before the special is placed.

**** END OF SECTION ****

SECTION 02666 – WATER PIPELINE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall flush and test pipelines and appurtenant piping, and disinfect potable water pipelines and appurtenant piping, complete, including providing test water and the disposal thereof.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 02630 Ductile Iron Pipe
3. Section 02645 PVC Pressure Pipe (4 in. and Smaller)
4. Section 02646 PVC Pressure Pipe (Larger than 4-inch)
5. Section 02650 Steel Pipe, Lined and Coated
6. Section 02653 Fabricated Steel Pipe Specials

1.3 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

- B. The Work of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:

1. California Plumbing Code

- C. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ANSI/AWWA B300 Hypochlorites
2. ANSI/AWWA B301 Liquid Chlorine
3. ANSI/AWWA C651 Disinfecting Water Mains
4. APHA, AWWA, and WEF Standard Methods for the Examination of Water and Wastewater

SECTION 02666 – WATER PIPELINE TESTING AND DISINFECTION

1.4 TESTING SCHEDULE

- A. The CONTRACTOR shall submit the following:
 - 1. A testing schedule, including proposed plans for water conveyance, control, and disinfection shall be submitted in writing for approval a minimum of 7 days before testing is to start. The submittal shall also include the CONTRACTOR's plan for obtaining sufficient flow to flush disinfection water, neutralization of chlorinated water from the pipeline, and the release of water from pipelines after testing and disinfection has been completed.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. All test equipment, chemicals for chlorination, temporary valves, temporary blow-offs, bulkheads, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR. No materials shall be used which would be injurious to the pipeline or its future function.
- B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:
 - 1. In combination with appropriate gas flow chlorinators and ejectors;
 - 2. Under the direct supervision of an experienced technician;
 - 3. When appropriate safety practices are observed.
- D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise indicated, potable water for testing and disinfecting water pipelines shall be furnished by the CONTRACTOR. The CONTRACTOR shall also make all necessary arrangements for conveying the water to the points of use.
- B. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the RESIDENT ENGINEER.

SECTION 02666 – WATER PIPELINE TESTING AND DISINFECTION

- C. Pipeline pressure tests will include hydrostatic pressure test of the complete pipeline, in segments as required to match pipe pressure class.

3.2 HYDROSTATIC TESTING OF POTABLE WATER PIPELINES

- A. Hydraulic testing of potable water pipelines shall be performed in accordance with SSPWC Subsection 306-8.9. Before starting hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. Backfilling shall be completed except at joints. The CONTRACTOR shall provide sufficient temporary air tapplings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least an hour 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 RESIDENT ENGINEER 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. The test pressure for pump station discharge piping (925 Zone) shall be 150 psi. The test pressure for reservoir inlet/outlet piping (725 Zone) shall be 30 psi. Test pressure for reservoir drain pump suction/discharge piping shall be 50 psi. The test pressure for reservoir overflow piping shall be 30 psi. All visible leaks shall be repaired in a manner acceptable to the RESIDENT ENGINEER.
- D. The maximum allowable leakage for distribution 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.

SECTION 02666 – WATER PIPELINE TESTING AND DISINFECTION

3.3 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 RESIDENT ENGINEER will make 24-hour chlorine residual tests. The RESIDENT ENGINEER 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 RESIDENT ENGINEER. 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.

SECTION 02666 – WATER PIPELINE TESTING AND DISINFECTION

- H. Neutralization of Chlorinated Water: The CONTRACTOR shall neutralize the chlorinated water prior to disposal. Neutralizing and disposing of chlorinated water shall be in accordance with Appendix "B" of AWWA Standard C651.

3.4 BACTERIOLOGICAL TESTING OF DISINFECTED POTABLE WATER PIPELINES

- A. The RESIDENT ENGINEER 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.

3.5 TESTING OF FLOOR DRAIN

- A. Floor drain shall be tested for leakage in accordance with the requirements of the latest edition of SSPWC.

**** END OF SECTION ****

SECTION 02667 – TESTING AND DISINFECTION OF HYDRAULIC STRUCTURES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall perform cleaning, flushing, and testing of all hydraulic structures, pumping equipment and appurtenant piping. The CONTRACTOR shall disinfect hydraulic structures, pumping equipment, and appurtenant piping to be used for potable water, including providing test water and the disposal thereof.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 03300 Cast-In Place Concrete

1.3 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

- A. The following commercial standards are referenced in this Section:
 - 1. ANSI/AWWA B300 Hypochlorites
 - 2. ANSI/AWWA B301 Liquid Chlorine
 - 3. ANSI/AWWA C652 Disinfection of Water-Storage Facilities
 - 4. ANSI/AWWA D100 Welded Steel Tanks for Water Storage

1.4 CONTRACTOR SUBMITTAL

- A. All submittals shall be in strict accordance with the requirements of Section 01300 - Submittals.
- B. The CONTRACTOR shall submit a written testing schedule including proposed plans for water conveyance, control, disposal, and disinfection for approval a minimum of 7 days before testing is to start.

SECTION 02667 – TESTING AND DISINFECTION OF HYDRAULIC STRUCTURES

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the CONTRACTOR subject to the RESIDENT ENGINEER's review. No materials shall be used which would be injurious to the construction or its future function.

- B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301; sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300. Liquid chlorine shall be used only:
 - 1. In combination with appropriate gas flow chlorinators and ejectors;
 - 2. Under the direct supervision of an experienced technician;
 - 3. When appropriate safety practices are observed.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Water for testing and disinfecting shall be furnished by the CONTRACTOR, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-identified source to the points of use.

- B. All hydraulic structures, pumping equipment and appurtenant pressure piping shall be tested; those for potable water shall also be disinfected. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be done in the presence of the RESIDENT ENGINEER.

- C. In the case of a reservoir, testing and disinfecting operations shall be combined.

- D. Disinfection operations shall be scheduled as late as possible during the construction schedule to ensure the maximum degree of sterility of the facilities at the time the Work is accepted by the RESIDENT ENGINEER. Bacteriological testing shall be performed by a certified testing laboratory acceptable to the RESIDENT ENGINEER. Results of the bacteriological testing shall be satisfactory to the State Department of Health or other appropriate regulatory agency.

- E. If industrial paint finishes or other protective coatings are to be applied to the interior surfaces of the hydraulic structure, such coatings shall be applied after all testing operations have been completed but prior to disinfection, except that in the case of reservoirs, such coatings shall be applied before the combined testing and disinfecting operations.

SECTION 02667 – TESTING AND DISINFECTION OF HYDRAULIC STRUCTURES

- F. Releases of water from structures, pumping equipment and appurtenant piping after testing and disinfecting have been completed, shall be acceptable to the RESIDENT ENGINEER.

3.2 PRELIMINARY CLEANING AND FLUSHING

- A. Before both testing and disinfecting, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gallons per minute (gpm). All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.
- B. Before both testing and disinfecting, all pumping equipment and appurtenant components and piping shall be cleaned and thoroughly flushed. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the equipment and appurtenances or otherwise removed.

3.3 TESTING OF HYDRAULIC STRUCTURES

- A. General: Testing shall be performed prior to backfilling, except where otherwise acceptable to the RESIDENT ENGINEER. Testing shall not be performed sooner than 14 days after all portions of the structure walls and associated roof systems have been completed. The test shall consist of filling the structure with water to the maximum operating water surface. The rate of filling shall not exceed 24 inches of depth per day. All visible leakage shall be repaired.
- B. Leakage Test and Repairs: After the structure has been filled, the water loss leakage test shall be performed as follows: an initial water level reading shall be made. Seven days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the two water level readings, does not exceed 0.2 percent of the total volume of water in the structure, after allowance is made for evaporation loss. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 7-day period and appropriate action taken to correct the problem before commencing a new 7-day test period. Should the structure fail to pass the test, the test shall be repeated for up to three additional 7-day test periods.
 - 1. If, at the end of 28 days, the structure still fails to pass the leakage test, the CONTRACTOR shall empty the structure as acceptable to the RESIDENT ENGINEER and shall examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage. Any cracks shall be "vee'd" and sealed in accordance with Section 03300 - Cast-in-Place Concrete. Any evidence of leakage shall be repaired. Following these operations, test the hydraulic structure again. The structure will not be

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accepted as completed until the water loss leakage test is passed and all visible leakage repaired. In the case of a reservoir, the retesting shall again be combined with disinfection, exclusive of the spraying operation.

2. Leaks in steel structures shall be repaired by chipping, gouging, or oxygen gouging and rewelding according to ANSI/AWWA D100. Following repair, test the structure again. The structure will be accepted when the leakage test is passed and all visible leakage is repaired. Retesting shall be combined with disinfection.

3.4 TESTING OF PUMPING EQUIPMENT AND APPURTENANT PIPING

- A. Pumping equipment and piping appurtenant to hydraulic structures shall be tested as indicated in Section 02666 - Water Pipeline Testing and Disinfection.

3.5 DISINFECTION OF HYDRAULIC STRUCTURES AND APPURTENANT PIPELINES

- A. All hydraulic structures and pumping equipment which store or convey potable water shall be disinfected by chlorination. Chlorination of hydraulic structures and pumping equipment shall be performed in accordance with the requirements of ANSI/AWWA C652 using a combination of chlorination Methods 2 and 3 as modified herein.
- B. Chlorination: A strong chlorine solution (about 200 mg/L) shall be sprayed on all interior surfaces of the structure. Following this, the structure shall be partially filled with water to a depth of approximately 1 foot. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution-feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the inflowing water. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 50 mg/L upon completion of the partial filling operation. Precautions shall be taken to prevent the strong chlorine solution from flowing back into the liens supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the heavily chlorinated water.
- C. Retention Period: Chlorinated water shall be retained in the partially filled structure, pumping equipment, and appurtenant piping long enough to destroy all non-spore-forming bacteria, and in any event, for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 25 mg/L. All valves shall be operated while the liens are filled with the heavily chlorinated water.
- D. Final Filling of Structure: After the free chlorine residual has been checked, and has been found to satisfy the above requirement, the water level in the structure

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shall be raised to its final elevation by addition of potable water and held for at least 24 hours. Before the final filling is commenced, the quantity of heavily-chlorinated water remaining in the structure after filling the piping shall, unless otherwise acceptable to the RESIDENT ENGINEER, be sufficient, when the water level is raised to its final elevation to produce a free chlorine residual of between 1 and 2 mg/L. After the structures have been filled, the strength of the chlorinated water shall be determined. If the free chlorine residual is less than 1 mg/L, an additional dosage shall be applied to the water in the structure. If the free chlorine residual is greater than 2 mg/L, the structure shall be partially emptied and additional potable water added. After 24 hours, the free chlorine residual shall be no less than 1 mg/L or an additional dosage shall be applied and the residual tested again after 24 hours. In no case shall water be released prior to the expiration of the required retention period.

3.6 BACTERIOLOGICAL SAMPLING AND TESTING

- A. Disinfected water storage facilities shall be sampled and tested in accordance with ANSI/AWWA C652.

3.7 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

**** END OF SECTION ****

SECTION 02760– COMPACT PROPRIETARY BIOFILTRATION BEST MANAGEMENT PRACTICES (BMPS)

PART 1 – GENERAL

2.1. PURPOSE

- A. The purpose of this specification is to establish generally acceptable criteria for Compact Proprietary Biofiltration Best Management Practices (BMPs) used for biofiltration of stormwater runoff including dry weather flows and other contaminated water sources.
- B. Work of this Section. The CONTRACTOR shall provide the Compact Proprietary Biofiltration BMP with associated piping, plants and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.

2.2. DESCRIPTION

- A. Compact Proprietary Biofiltration BMPs are used for filtration of stormwater runoff including dry weather flows. The required Compact Proprietary BMP shall include a pre-engineered biofiltration system composed of a pretreatment chamber containing filtration cartridges, a horizontal flow biofiltration chamber with a peripheral void area and a centralized and vertically extending underdrain, the biofiltration chamber containing a sorptive media mix which does not contain any organic material and a layer of plant establishment media, and a discharge chamber containing an orifice control structure. Treated water flows horizontally in series through the pretreatment chamber cartridges, biofiltration chamber and orifice control structure.
- B. Function - The Compact Proprietary Biofiltration BMP has no moving internal components and functions based on gravity flow, unless otherwise specified. The Compact Proprietary Biofiltration BMP shall be composed of a pretreatment chamber, a biofiltration chamber and a discharge chamber. The pretreatment device houses cartridge media filters, which consist of filter media housed in a perforated enclosure. The untreated runoff flows into the system via subsurface piping and or surface inlet. Water entering the system is forced through the filter cartridge enclosures by gravity flow. Then the flow contacts the filter media. The flow through the media is horizontal toward the center of each individual media filter. In the center of the media shall be a round slotted PVC pipe of no greater than 1.5-inch in diameter. The slotted PVC pipe shall extend downward into the water transfer cavity of the cartridge. The slotted PVC pipe shall be threaded on the bottom to connect to the water

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transfer cavity. After pollutants have been removed by the filter media the water discharges the pretreatment chamber and flows into the water transfer system and is conveyed to the biofiltration chamber. Once runoff has been filtered by the biofiltration chamber it is collected by the vertical underdrain and conveyed to a discharge chamber equipped with a flow control orifice plate. Finally the treated flow exits the system.

- C. Pollutants - The Compact Proprietary Biofiltration BMP shall remove and retain debris, sediments, TSS, dissolved and particulate metals and nutrients including nitrogen and phosphorus species, bacteria, BOD, oxygen demanding substances, organic compounds and hydrocarbons entering the filter during frequent storm events and continuous dry weather flows.
- D. Treatment Flow Rate and Bypass - The Compact Proprietary Biofiltration BMP shall operate as an in-line system. The Compact Proprietary Biofiltration BMP shall treat 100% of the required water quality treatment flow. The size of the system must match those provided on the drawing to ensure proper performance and hydraulic residence time.

2.3. MANUFACTURER

- A. The manufacturer of the Compact Proprietary Biofiltration BMP shall be one that is regularly engaged in the engineering design and production of systems developed for the treatment of stormwater runoff for at least ten (10) years. In accordance with the drawings, the Compact Proprietary Biofiltration BMP shall be a flow-based filter device manufactured by Bio Clean Environmental Services (i.e., Modular Wetland Systems) or approved equivalent.

2.4. RELATED WORK

- C. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 02200 Earthwork

2.5. REFERENCE STANDARDS

- A. ASTM C 2 Standard Test Method for Unit Weight and Voids in

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MANAGEMENT PRACTICES (BMPS)**

Aggregate

B.	ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C.	ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine
D.	ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
E.	ASTM C 330	Standard Specification for Lightweight Aggregate for Structural Concrete
F.	ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft ³ (600 kN-m/m ³))
G.	ASTM D 1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
H.	ASTM D 1777	Standard Test Method for Thickness of Textile Materials
I.	ASTM D 4716	Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
J.	AASHTO T 99-01	Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop
K.	AASHTO T 104	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
L.	AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw

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Materials

M.	AASHTO T 288	Standard Method of Test for Determining Minimum Laboratory Soil Resistivity
N.	AASHTO T 289	Standard Method of Test for Determining ph of Soil for Use in Corrosion Testing
O.	AASHTO T 291	Standard Method of Test for Determining Water Soluble Chloride Ion Content in Soil
P.	AASHTO T 290	Standard Method of Test for Determining Water Soluble Sulfate Ion Content in Soil

2.6. SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals:
 - 1. Shop drawings are to detail the Compact Proprietary Biofiltration BMP and all components required and the sequence for installation, including:
 - a. Biofiltration BMP model number, size and treatment flow rate
 - b. System configuration with primary dimensions
 - c. Interior components
 - d. Any accessory equipment called out on shop drawings
 - 2. The CONTRACTOR shall submit inspection and maintenance documentation upon request.

- B. The Compact Proprietary Biofiltration BMP manufacturer shall submit to the RESIDENT ENGINEER a "Manufacturer's Performance Certification" certifying the Compact Proprietary Biofiltration BMP is Washington State Technology Assessment Protocol-Ecology certified and is designed to meet the treatment flow rate as listed in the Priority Development Project Storm Water Quality Management Plan, plan set or CONTRACT DOCUMENTS.

2.7. WARRANTY

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- A. The Manufacturer shall guarantee the Compact Proprietary Biofiltration BMP against all manufacturing defects in materials and workmanship for a period of five (5) years from the date of acceptance. The manufacturer shall be notified of repair or replacement issues in writing within the warranty period. The Compact Proprietary Biofiltration BMP is limited to recommended application for which it was designed.

2.8. MANUFACTURER WORK INCLUDED

- A. Specification requirements for installation of Compact Proprietary Biofiltration BMP.
- B. The manufacturer shall examine the site conditions, intended application, and operation of the Compact Proprietary Biofiltration BMP and give recommendations to the contractor of work.
- C. Manufacturer to supply components of the Compact Proprietary Biofiltration BMP:
- Pretreatment chamber components (pre-assembled)
 - Concrete Structure(s)
 - Biofiltration chamber components (pre-assembled)
 - Flow control discharge structure (pre-assembled)

PART 2 – MATERIALS

2.1. COMPONENTS

- A. The Compact Proprietary Biofiltration BMP and all of its components shall be self-contained within a concrete structure constructed of concrete with a minimum 28 day compressive strength of 5,000 psi, with reinforcing per ASTM A 615, Grade 60, and supports and H2O loading as indicated by AASHTO. Each Chamber shall have appropriate access hatches for easy maintenance and sized to allow removal of all internal components without disassembly. All water transfer system components shall conform with the following;
1. Filter netting shall be 100% Polyester with a number 16 sieve size, and strength tested per ASTM D 3787.
 2. Drainage cells shall be manufactured of lightweight injection-molded plastic and have a minimum compressive strength test of 6,000 psi and

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a void area along the surface making contact with the filter media of 75% or greater. The cells shall be at least 2" in thickness and allow water to freely flow in all four directions.

2.2. PRETREATMENT CHAMBER COMPONENTS

- A. Filter Cartridges shall operate at a loading rate not to exceed 3 gallons per minute per square foot surface area.
- B. Drain Down System shall include a pervious floor that allows water to drain into the underdrain pipe that is connected to the discharge chamber.

2.3. BIOFILTRATION CHAMBER COMPONENTS

- A. Media shall consist of ceramic material produced by expanding and vitrifying select material in a rotary kiln. Media must be produced to meet the requirements of ASTM C330, ASTM C331, and AASHTO M195. Aggregates must have minimum 24-hour water absorption of 10.5% mass. Media shall not contain any organic material. Flow through media shall be horizontal from the outer perimeter of the chamber toward the centralized and vertically extending underdrain. The retention time in the media shall be at least 3 minutes. Downward flow filters are not acceptable alternatives. The thickness of the media shall be at least 19-inches from influent end to effluent end. The loading rate on the media shall not exceed 1.1gallons per minute per square foot surface area. Media must be contained within structure that spaces the surface of the media at least 2" from all vertically extending walls of the concrete structure.
- B. Planting shall be native, drought tolerant species recommended by the manufacture and/or the landscape architect as Identified in the plan set and/or contract documents.
- C. Plant Support Media shall be made of a 3-inch thick moisture retention cell that is inert and contains no chemicals or fertilizers, is not made of organic material and has an internal void percentage of 80%.

2.4. DISCHARGE CHAMBER

- A. The discharge device shall house a flow control orifice plate that restricts flows greater than designed treatment flow rate. All piping components shall be made of a high-density polyethylene. The discharge chamber shall also contain a drain down filter if specified on the drawing.

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MANAGEMENT PRACTICES (BMPS)**

PART 3 – EXECUTION

3.1. GENERAL

- A. The installation of the Compact Proprietary Biofiltration BMP shall conform to all applicable national, state, state highways, municipal and local specifications.

3.2. INSTALLATION

- A. Grading and Excavation site shall be properly surveyed by a registered professional surveyor, and clearly marked with excavation limits and elevations. After site is marked it is the responsibility of the contractor to contact local utility companies and/or DigAlert to check for underground utilities. All grading permits shall be approved by governing agencies before commencement of grading and excavation. Soil conditions shall be tested in accordance with the governing agencies requirements. All earth removed shall be transported, disposed, stored, and handled per governing agencies standards. It is the responsibility of the contractor to install and maintain proper erosion control measures during grading and excavation operations.
- B. Compaction – All soil shall be compacted per registered professional soils engineer’s recommendations prior to installation of Compact Proprietary Biofiltration BMP components.
- C. Backfill shall be placed according to a registered professional soils engineer’s recommendations, and with a minimum of 6-inch of gravel under all concrete structures.
- D. Concrete Structures – After backfill has been inspected by the governing agency and approved the concrete structures shall be lifted and placed in proper position per plans.
- E. Subsurface Flow Wetland Media shall be carefully loaded into area so not to damage the Wetland Liner or Water Transfer Systems. The entire wetland area shall be filled to a level 9 inches below finished surface.
- F. Planting layer shall be installed per manufacturer’s drawings and consist of a minimum 3-inches grow enhancement media that ensures greater than 95% plant survival rate, and 6-inches of wetland media. Planting shall consist of native plants to include Juncus Patens “Elk Blue”. Planting shall be drip

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irrigated for at least the first 3 months to insure long term plant growth. No chemical herbicides, pesticides, or fertilizers shall be used in the planting or care and maintenance of the planted area.

3.3. SHIPPING, STORAGE AND HANDLING

- A. Shipping – Compact Proprietary Biofiltration BMP shall be shipped to the contractor's address or job site, and is the responsibility of the contractor to offload the unit(s) and place in the exact site of installation.
- B. Storage and Handling– The contractor shall exercise care in the storage and handling of the Compact Proprietary Biofiltration BMP and all components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor. The Compact Proprietary Biofiltration BMP and all components shall always be stored indoors and transported inside the original shipping container until the unit(s) are ready to be installed. The Compact Proprietary Biofiltration BMP shall always be handled with care and lifted according to OSHA and NIOSA lifting recommendations and/or contractor's workplace safety professional recommendations.

3.4. MAINTENANCE AND INSPECTION

- A. Inspection – The contractor shall notify the Design Engineer (7) seven days before the installation of the Compact Proprietary Biofiltration BMP so a site visit can be conducted. After installation, the contractor shall demonstrate that the Compact Proprietary Biofiltration BMP has been properly installed at the correct location(s), elevations, and with appropriate components. All components associated with the Compact Proprietary Biofiltration BMP and its installation shall be subject to inspection by the engineer at the place of installation. In addition, the contractor shall demonstrate that the Compact Proprietary Biofiltration BMP has been installed per the manufacturer's specifications and recommendations. All components of the Compact Proprietary Biofiltration BMP shall be inspected pursuant to the plan sheets.
- B. Maintenance – Operation and Maintenance Information should be in accordance with Section 01730. The manufacturer recommends cleaning and debris removal maintenance of once a year and replacement of the Cartridge Filters as needed. The maintenance shall be performed by someone qualified. A Maintenance Manual is available upon request from the manufacturer. The manual shall provide detailed information regarding the maintenance of the Compact Proprietary Biofiltration BMP. A Maintenance/Inspection record

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shall be kept by the maintenance operator. The record shall include any maintenance activities performed, amount and description of debris collected, and the condition of the filter.

- C. Material Disposal - All debris, trash, organics, and sediments captured by the Compact Proprietary Biofiltration BMP shall be transported and disposed of at an approved facility for disposal in accordance with local and state requirements. Please refer to state and local regulations for the proper disposal of toxic and non-toxic material.

**** END OF SECTION ****

SECTION 02768 – PERMEABLE INTERLOCKING CONCRETE PAVERS

PART 1 – GENERAL SPECIFICATIONS

1.1 SECTION INCLUDES

- A. Work consists of furnishing and construction of a permeable interlocking concrete pavement system in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.
- B. Installation work includes:
 - 1. Verifying subgrade is to the lines, grades, infiltration rate, and density shown on the construction drawings;
 - 2. furnishing and installing geotextile and/or membrane liner (where required), horizontal drainage piping (where required), sub-base course, base course, bedding course, edge restraint, concrete pavers and permeable joint material to the lines and grades shown on the construction drawings.

1.2 RELATED SECTIONS

- C. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 02200 Earthwork
 - 3. Section 02360 Compact Proprietary Biofiltration BMP
 - 4. Section 02644 PVC Nonpressure PIPE
 - 5. Section 03100 Concrete Formwork
 - 6. Section 03310 Cast-in-Place Site Work Concrete

1.3 REFERENCES

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. AASHTO GDPS-4-M Guide for Design of Pavement Structures

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2.	ASCE 58-10	Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways
3.	ASTM C-29	Bulk Density (“Unit Weight”) and Voids in Aggregate
4.	ASTM C-94	Standard Specification for Ready Mixed Concrete
5.	ASTM C-131	Resistance to Degradation of Small-Sized Course Aggregate by Abrasion and Impact in the Los Angeles Machine
6.	ASTM C-136	Sieve Analysis of Fine and Course Grained Aggregates
7.	ASTM C-140	Sampling and Testing Concrete Masonry Units and Related Units
8.	ASTM C-936	Solid Concrete Interlocking Paving Units
9.	ASTM C-979	Pigments for Integrally Colored Concrete
10.	ASTM C-1645	Freeze-thaw and De-icing Salt Durability of Solid Interlocking Paving Units
11.	ASTM D-448	Standard Classification for Sizes of Aggregates for Road and Bridge Construction
12.	ASTM D-698	Laboratory Compaction Characteristics of Soil Using Standard Effort
13.	ASTM D-1557	Laboratory Compaction Characteristics of Soil Using Modified Effort
14.	ASTM D-1883	CBR (California Bearing Ratio) of Laboratory Compacted Soils
15.	ASTM D-2488	Description and Identification of Soils (Visual-Manual Procedure)
16.	ASTM D-3034	Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
17.	ASTM D-3350	Polyethylene Plastic Pipe and Fittings Materials
18.	ASTM D-4873	Identification, Storage and Handling of Geosynthetic Rolls and Samples
19.	ASTM D-6928	Resistance of Course Aggregates to Degradation by Abrasion in the Micro-Deval Apparatus
20.	ICPI	Permeable Interlocking Concrete Pavement manual (latest edition)
21.	ICPI	Permeable Design Pro software for hydrologic and structural design
22.	ICPI	Tech Spec Technical Bulletins.

SECTION 02768 – PERMEABLE INTERLOCKING CONCRETE PAVERS

1.4 SUBMITTALS

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

- A. CONTRACTOR shall submit to the RESIDENT ENGINEER for approval, and retain for the balance of the project, a minimum of four full size samples of each concrete paver type/size/thickness/color/finish specified; the samples shall represent the range of shape, texture and color permitted for the respective type. Color(s) will be selected by RESIDENT ENGINEER from Manufacturer's standard colors.
- B. Prior to delivery of the associated material to the site, the CONTRACTOR shall submit the following product specific documentation for approval:
 - 1. Aggregates
 - a. Sieve analysis per ASTM C-136
 - b. Durability of aggregates using Micro Deval Degradation using ASTM D-6928.
 - c. Percentage of angular and sub-angular particles per ASTM D-2488.
 - d. Minimum 3 lb sample of each material for independent testing.
 - e. Source test results for void ratio and bulk density of the Base and Sub-base aggregates per ASTM C-29.
 - 2. Concrete Pavers:
 - a. Test results from an independent testing laboratory for compliance to ASTM C-936 or other applicable requirements.
 - b. For machine installation projects, stitching details to be used during product placement as supplied by the manufacturer.
 - c. Warranty documentation
 - d. Close out operations and maintenance program
 - e. Material Safety Data Sheets
 - 3. Geosynthetics
 - a. One 18 inch x 18 inch panel of each geosynthetic (geotextile or membrane liner) for inspection and testing. The sample panels shall be uniformly rolled and shall be wrapped in plastic to protect the material from moisture and damage during shipment. Samples shall be externally tagged for easy identification. External identification shall

SECTION 02768 – PERMEABLE INTERLOCKING CONCRETE PAVERS

include: name of manufacturer; product type; product grade; lot number; and physical dimensions.

- b. Material Safety Data Sheets
- 4. Written Method Statement and Quality Control Plan that describes material staging and flow, paving direction and installation procedures, including representative reporting forms that ensure conformance to the project specifications.

1.5 QUALITY ASSURANCE

- A. CONTRACTOR shall submit a list of five (5) previously constructed projects of similar size and magnitude prior to bid date to be qualified. Contact names and telephone numbers shall be listed for each project with date of completion.
- B. CONTRACTOR to reference ICPI Technical Specification and manufacture recommendations for mechanically installed projects.
- C. At a minimum, the CONTRACTOR's Site Foreman shall hold PICP Technician Certificate from the Interlocking Concrete Pavement Institute (ICPI) Contractor certification program. The Site Foreman is expected to be onsite for the entire installation.
- D. CONTRACTOR shall conform to all local, state/provincial licensing and bonding requirements.
- E. CONTRACTOR will hold a mandatory pre-construction meeting with RESIDENT ENGINEER, and affected sub-trades accessing PICP work area to review method statement and quality control plan and communicate to all parties a work flow that is most desirable to meet the construction schedule as set forth by the General CONTRACTOR. Additional details of Pre-Construction meeting are outlined in Section 6-1.7 of the City of San Diego's supplement to the SSPWC.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
- C. CONTRACTOR shall check all materials upon delivery to assure that the proper materials have been received and are in good condition before signing off on the manufacturer's packing slip.

SECTION 02768 – PERMEABLE INTERLOCKING CONCRETE PAVERS

- D. CONTRACTOR shall protect all materials from damage or contamination due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged or contaminated materials shall not be incorporated into the work.
- E. Deliver Concrete Pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload and store concrete pavers at job site in such a manner that no damage occurs to the product.
- F. Handle and transport aggregates to avoid segregation, contamination and degradation. Keep different materials sufficiently separated as to prevent mixing. Do not dump or store one material on top of another unless it is part of the installation process. Cover material with waterproof covering to prevent exposure to rainfall or removal by wind – secure the covering in place.
- G. Geosynthetics shall be delivered, stored and handled in accordance with ASTM D-4873.

1.7 ENVIRONMENTAL CONDITIONS

- A. Do not install during heavy rain, freezing conditions or snowfall.
- B. Do not install on frozen soil subgrade or aggregates.
- C. Do not install frozen aggregates.

1.8 MAINTENANCE MATERIALS

- A. Provide 100 square feet additional paver material for use by RESIDENT ENGINEER for maintenance and repair as attic stock.
- B. Pavers to be from the same production run as installed materials.
- C. Store paver materials in RESIDENT ENGINEER designated location.

PART 2 – PRODUCTS

2.1 DEFINITIONS

- A. Base Course – within the context of this specification, a washed open graded free draining aggregate material (#57 Stone) of a designed thickness that provides both structural support over the sub-base and water storage capacity (within the voids). It also serves as a choking material between the bedding course and sub-base.

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- B. Bedding Course – within the context of this specification, a two-inch thick layer of washed open graded free draining aggregate material (#8 stone) loosely screeded smooth for bedding of the concrete pavers.
- C. Concrete Pavers – within the context of this specification, solid individual paving units manufacturing from concrete that are either specifically designed for use in permeable applications (include joints and voids) or are laid in a pattern that creates large enough openings to provide infiltration. Concrete pavers are shipped in clusters called bundles or cubes, which consist of several layers of pavers strapped or wrapped together.
 - 1. Voids – larger openings between the individual pavers that provide for infiltration.
 - 2. Joints – smaller openings between the individual pavers that provide vertical and horizontal interlock between units.
- D. Edge Restraint – A cast in place concrete curb, building or other stationary object that prevents the lateral movement of the bedding course and concrete pavers so they do not spread and loose interlock. Other edge restraints options include plastic, steel or aluminum edging, cut stone, precast concrete and submerged concrete edge complete with mortared pavers must be utilized during installation.
- E. Geotextile – Woven or non-woven fabrics made from plastic fibers used primarily for separation between sub-base and subgrade.
- F. Horizontal Drainage Piping – series of horizontal pipes within the sub-base that discharge to a catch basin, ditch or other receiving body beyond the extent of the paved area. Piping is typically elevated in a partial exfiltration system, and at the bottom of the sub-base in a no exfiltration system.
- G. Laying Face – the working edge of the pavement where the laying of pavers is occurring.
- H. Mechanical Installation - The use of specialized machines to lift whole layers of pavers from the bundles and place them on the prepared bedding course. These specialized machines are designed specifically for this application.
- I. Membrane Liner – impermeable liner placed at the bottom and sides of a no exfiltration system, used to prevent the exfiltration/discharge of water other than through the horizontal drainage piping. Usually includes a geotextile on top (possibly bottom) for protection.
- J. Permeable Joint Material – a washed open graded free draining aggregate material (typically #8, #89 or #9 Stone) used to fill the spaces (joints and voids) between concrete pavers to create interlock and still maintain infiltration.

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- K. Permeable Interlocking Concrete Pavement System – a system of paving consisting of concrete pavers placed in an interlocking pattern with the joints and voids filled with permeable joint material. The minimum rate of infiltration of the concrete pavers and permeable jointing material is 10 inches per hour, or the design storm, whichever is greater. The bedding course, base course and sub-base courses provide structural support over the Subgrade and stores, exfiltrates (into the Subgrade) and/or drains the infiltrating water.
- L. Sub-base Course – within the context of this specification, an open graded free draining aggregate material (#2 Stone) of a designed thickness that provides both structural support over the subgrade and water storage capacity (within the voids).
- M. Subgrade – the soil upon which the pavement structure and shoulders are constructed.

2.2 CONCRETE PAVERS

- A. The concrete paver products required include:

Belgard: Eco Dublin 3pc 80mm (or approved equivalent)
Color and Finish TBD by RESIDENT ENGINEER
- B. In the submittals, CONTRACTOR to provide manufacture recommended permeable paver installation pattern to avoid long continuous lines which are subject to failure. The manufacture to also provide recommended minimum thickness, and maximum aspect ratio, of pavers used in light vehicular application
- C. Concrete Pavers shall conform to the following requirements set forth in ASTM C-936:
 - 1. Measured length or width of test specimens shall not differ by more than +/- 0.063 in, while measured thickness shall not differ by more than +/- 0.125 in.
 - 2. Average compressive strength of 8,000 psi (55 MPa) with no individual unit under 7,200 psi (50 MPa) when tested in accordance with ASTM C-140.
 - 3. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C-140.
 - 4. Where freeze-thaw testing is required, the average mass loss of all specimens tested shall not be greater than (A) 225 g/m² when subject to 28 freeze thaw cycles, or (b) 500 g/m² when subject to 49

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freeze thaw cycles. Testing shall be conducted using a 3% saline solution in according to ASTM C-1645.

- D. Pigment in concrete pavers shall conform to ASTM C-979.

2.3 BEDDING COURSE

- A. Clean, non-plastic aggregate, free from deleterious or foreign matter, manufactured from crushed rock.
- B. Micro Deval Degradation of less than 8% as per ASTM D-6938.
- C. Percent of angular and sub-angular particles greater than 90%. Do not use rounded river gravel.
- D. LA Abrasion <40 as per ASTM C-131, minimum CBR of 80% as per ASTM D-1883.
- E. Gradation to conform to Table 1 as tested in accordance to ASTM C-136. All aggregates shall have equal to or less than 2% passing the No. 200 (0.075 mm) sieve.

Table 1
Grading Requirements for Bedding Course (ASTM No. 8 Stone per ASTM D-448)

Sieve Size	Percent Passing
1/2 in. (12.5 mm)	100
3/8 in.(9.5 mm)	85 to 100
No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5

2.4 PERMEABLE JOINTS

- A. Joints should be greater than or equal to 12.5mm, use ASTM No. 8 Stone as specified for the bedding course. CONTRACTOR to ensure joints are ADA compliant.

2.5 BASE AND SUB-BASE

- A. Clean, non-plastic aggregate, free from deleterious or foreign matter, manufactured from crushed rock.
- B. Micro Deval Degradation of less than 8% as per ASTM D-6938.
- C. Percent of angular and sub-angular particles greater than 90%. Do not use rounded river gravel.

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- D. LA Abrasion <40 as per ASTM C-131, minimum CBR of 80% as per ASTM D-1883.
- E. Gradation of base course to conform to Table 2 as tested in accordance to ASTM C-136. Gradation of sub-base course to conform to Table 3 as tested in accordance to ASTM C-136. All aggregates shall have equal to or less than 2% passing the No. 200 (0.075 mm) sieve.

Table 2
Grading Requirements for Base Course (ASTM No. 57 Stone per ASTM D-448)

Sieve Size	Percent Passing
1-½ in. (37.5 mm)	100
1 in. (25 mm)	95 to 100
½ in. (12.5 mm)	25 to 60
¾ in. (9.5 mm)	0 to 10
No. 4 (4.75 mm)	0 to 5

Table 3
Grading Requirements for Sub-base Course (ASTM No. 2 Stone per ASTM D-448)

Sieve Size	Percent Passing
3 in. (75 mm)	100
2- ½ in. (63 mm)	90 to 100
2 in. (50 mm)	35 to 70
1-½ in. (37.5 mm)	0 to 15
¾ in. (19 mm)	0 to 5

2.6 EDGE RESTRAINTS

- A. Edge restraints shall be cast in place concrete curbs constructed at a minimum to the dimensions of the municipal standards. Manufacture to provide detail of edge restraints in the submittal for approval.

2.7 GEOSYNTHETICS

- A. Where required, Geotextile and/or Membrane Liner materials shall pursuant to the manufactures recommendations: 30 mil PVC liner with 8 oz. nonwoven protective geotextile and specification section 02274-Geotextile.

2.8 HORIZONTAL DRAINAGE PIPING

- A. The horizontal drainage piping shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034, or corrugated HDPE pipe manufactured in accordance with ASTM D-3350.

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PART 3 – EXECUTION

3.1 INSPECTION

- A. Prior to commencement of any work, the CONTRACTOR shall conduct a pre-construction meeting with the RESIDENT ENGINEER and affected sub-trades. The pre-construction meeting should, at a minimum, verify:
1. The site layout conforms to the site plan. In particular, the location and elevation of discharge points (if any) of the horizontal drainage pipes.
 2. The excavation work conforms to the specified lines and elevations. Subgrade shall be trimmed to within 0 and ½ in of the specified grades. The surface of the prepared Subgrade shall not deviate by more than 3/8 in from the bottom edge of a 10-foot straight edge laid in any direction.
 3. The condition of the subgrade, in particular that the surface infiltration (where desired) has not been adversely impacted by the excavation work. Where compaction is desired, that the compaction densities have been met.
 4. Locations of curbs, grade beams, utility structures, light standards, tree wells or any other protrusions as applicable to the project.
 5. The details of the site's 'Permanent BMP Plan Sheets'.
 6. Panel installation drawings for the geosynthetics, in particular the location of any protrusions through the membrane liner where boots are required.
- B. Although the RESIDENT ENGINEER may provide soil testing and quality assurance inspection during earthwork and subgrade preparation, the RESIDENT ENGINEER's quality assurance program does not relieve the CONTRACTOR of responsibility for quality control and system performance. CONTRACTOR shall obtain any quality control testing or inspection not provided by the RESIDENT ENGINEER that is necessary to satisfy the CONTRACTOR with the condition of the subgrade prior to commencement of the work. This may include:
1. Proof rolling of the subgrade to determine presence of soft spots or localized pockets of objectionable materials.
 2. Infiltration testing to verify the subgrade has not been adversely impacted.

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3. Compaction testing.

- C. Where deficiencies or inconsistencies are identified, the CONTRACTOR shall notify the RESIDENT ENGINEER in writing. The CONTRACTOR will not proceed with the work until the RESIDENT ENGINEER has verified that the deficiencies or inconsistencies have been addressed.
- D. Beginning of Installation means acceptance of subgrade.

3.2 INSTALLATION BASE COURSE

- A. Keep area where pavement is to be constructed free from sediment during the entire job. Any materials contaminated with sediment shall be removed and replaced with clean material.
- B. Install membrane liner in accordance with the manufacturer's recommendations. The membrane liner is applied to the bottom and sides of the excavation. Allow for enough membrane liner to exceed the final elevation of the surface. After completion of the surface, the excess liner should be cut flush with the finished grade,
- C. Install geotextiles as required in accordance with the specifications and drawings. The geotextile is applied to the bottom and sides of the excavation with overlapping joints a minimum of 12 inches. Overlaps to follow down slope. Allow for enough geotextile to exceed the final elevation of the surface. After completion of the surface, the excess geotextile should be cut flush with the finished grade,
- D. Install the sub-base course and base course at the thicknesses, compaction rates, surface tolerances, and elevations outlined in the specifications.
 - 1. Place and spread the first layer of sub-base without displacing or damaging the geosynthetics (if used). To prevent damage, tracked vehicles must not be used to spread the initial sub-base layer.
 - 2. The aggregate should be spread and compacted in uniform layers not exceeding 6 inch loose thickness. Compaction is performed using either a 10 T (10 ton) vibratory roller or a minimum 13,500 lbf centrifugal force reversible vibratory plate compactor. For each lift, make at least two passes in the vibratory mode and at least two passes in the static mode – continue compaction until there is visible movement in the materials.
 - 3. At the specified elevation(s), install the horizontal drain pipes in accordance with the manufacturer's recommendations. Ensure the pipes are properly sloped to provide proper drainage to the outlets pipes shall be surrounded by a minimum of 4 inches of base course

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material to prevent damage from the sub-base material. Care must be taken not to damage horizontal drain pipes during subsequent aggregate installation.

4. Final surface tolerance should be plus or minus 1 inch over a 10 foot straight edge laid in any direction.
 5. Attention will be paid to providing proper compaction near curbs, grade beams, concrete collars around utility structures, lights standards, tree wells, building edges and other protrusions as applicable to the project. In areas not accessible to large compaction equipment, compact to specified density with mechanical tampers (jumping jacks).
- E. Before commencing the placing of the bedding course, the base shall be inspected by the RESIDENT ENGINEER.

3.3 INSTALLATION EDGE RESTRAINTS

- A. Adequate edge restraint shall be provided along the perimeter of all paving as specified. The face of the edge restraint, where it abuts pavers, shall be vertical.
- B. All concrete edge restraints shall be constructed to dimensions and level specified and shall be supported on a compacted Base not less than 6 inch thick.
- C. Concrete used for the construction of edge restraints shall be air-entrained and have a compressive strength as specified. All concrete shall be in accordance with ASTM C94 requirements.

3.4 INSTALLATION BEDDING COURSE, CONCRETE PAVERS AND PERMEABLE JOINT MATERIAL

- A. Spread the bedding course evenly over the base course and screed to a nominal 2 in. thickness. Do not use the bedding material to fill depressions in the base course surface.
- B. The CONTRACTOR shall screed the bedding course using either an approved mechanical spreader (e.g.: an asphalt paver) or by the use of screed rails and boards.
- C. Moisten and lightly compact the bedding course using a plate compactor. Surface tolerances shall be 3/8 inch over a 10-foot straight edge.
- D. Loose screed the bedding course.

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- E. Ensure that concrete pavers are free of foreign material before installation. Concrete pavers shall be inspected for color distribution and all chipped, damaged or discolored concrete pavers shall be replaced. Initiation of concrete paver placement shall be deemed to represent acceptance of the pavers.
- F. Lay the concrete pavers in the pattern(s) as shown on the drawings. Maintain straight pattern lines. For mechanical installations, follow the stitching details submittal as verified during the mock up.
- G. Paving units shall be installed from a minimum of 3 bundles for hand installations, 6 bundles for mechanical installations, simultaneously to ensure color blending.
- H. Joints between the individual concrete pavers shall be maintained according to the spacer bars.
- I. Fill gaps at the edges of the paved area with cut pavers or edge units. Do not install cut pavers smaller than one-third of a whole paver along edges subject to vehicular traffic – trim two pavers to fit.
- J. Cut pavers using a masonry saw. Upon completion of cutting, the area must be swept clean of all debris to facilitate inspection and to ensure the concrete pavers are not damaged during compaction.
- K. Using a low amplitude plate compactor capable of at least 5,000 lbs. (22 kN) compaction at a frequency of 75 hz –100 hz, compact and seat the concrete pavers into the bedding course.
- L. The pavers shall be compacted to achieve consolidation of the bedding course and brought to level and profile by not less than three passes. Initial compaction should proceed as closely as possible following the installation of the paving units and prior to the acceptance of any traffic or application of permeable joint material.
- M. Any units that are structurally damaged during compaction shall be immediately removed and replaced.
- N. Apply a dressing of Permeable Joint Material to the surface and sweep into the joints and voids. Fill joints and voids, then sweep off excess material before vibrating the material down into the joints using a plate compactor. This will require at least two or three passes with the compactor.
- O. Do not compact within 6 feet of the unrestrained edges of the paving units.

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- P. All work to within 3 ft (1 m) of the laying face must be left fully compacted at the end of each day. Cover the laying face with plastic sheets overnight if not closed with cut and compacted pavers.
- Q. Sweep off excess aggregate when the job is complete.

3.5 QUALITY ASSURANCE/QUALITY CONTROL

- A. Quality Assurance - The RESIDENT ENGINEER may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the CONTRACTOR from securing the necessary construction quality control testing.
- B. The CONTRACTOR shall notify the RESIDENT ENGINEER for visual observation once the PVC sub-drain piping network has been installed. The RESIDENT ENGINEER must be notified and approve the sub-drain piping network before releasing the CONTRACTOR to install the remaining subbase layers.
- C. Quality Assurance should include as a minimum verification with the RESIDENT ENGINEER that the CONTRACTOR's quality control plan and testing are adequate. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications.
- D. Quality Control – The CONTRACTOR shall engage inspection and testing services to perform the minimum quality control testing described in the design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.
- E. Quality control testing shall include backfill testing to verify soil types and compaction, and verification that the system is being constructed in accordance with the design plans and project specifications.

3.6 AS-BUILT CONSTRUCTION TOLERANCES

- A. Final inspection shall be conducted to verify conformance to the drawings after removal of excess aggregate. All pavements shall be finished to lines and levels to ensure positive drainage at all drainage outlets and channels.
- B. The final surface elevations shall not deviate more than +/- 3/8 inch under a 10 ft long straight edge.
- C. Lippage shall be no greater than 1/8 inch difference in height between adjacent pavers.
- D. Bond lines for the pavers shall be +/- 1/2 inch over a 50 foot string ling.

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3.7 PROTECTION AND MAINTENANCE

- A. At the completion of the work, the Manufacturer shall provide the RESIDENT ENGINEER with a "PICP System Maintenance Checklist" and sample "Long Term Performance and Maintenance Agreement".
- B. Once the work is complete, the RESIDENT ENGINEER shall be responsible for protecting the work from sediment deposition and damage due to subsequent construction activity on the site.
- C. The CONTRACTOR shall return to the site after 6 months from the completion of the work and conduct an inspection of the PICP System with the RESIDENT ENGINEER, Manufacturer and CONTRACTOR in accordance with the "PICP System Maintenance Checklist". The CONTRACTOR shall provide the following remedial work, as required, as part of the original bid and with no additional compensation: fill paver joints with stones; replace broken or cracked pavers; re-level settled pavers to specified elevations; and, re-align pavers to straighten bond lines. The RESIDENT ENGINEER shall be responsible for removal of debris either on the surface or within the joints, as required for the CONTRACTOR to properly conduct the necessary remedial work.

**** END OF SECTION ****

SECTION 02810 - LANDSCAPE IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Include all services, labor, materials, transportation, and equipment necessary to perform the work indicated on the Drawings and specified herein, and as required to properly complete the irrigation work and provide an operable system. The work includes:

1. Automatic irrigation system including piping, fittings, sprinkler heads, and accessories.
2. Valves, backflow preventers and fittings.
3. Controller, control wire.
4. Testing.
5. Excavating and backfilling irrigation system work.
6. Accessories to complete system.
7. Pipe sleeves.

B. Related work includes:

1. Section 01300 Submittals
2. Section 02050 Demolition
3. Section 02100 Site Preparation
4. Section 02200 Earthwork
- 5.
6. Section 02760 Compact Proprietary Biofiltration BMPs
7. Section 02768 Permeable Interlocking Concrete Pavers
8. Section 02900 Landscape Planting
9. Section 03310 Cast-in-Place Site Work Concrete
10. Section 16400 Low Voltage Electrical Service and Distribution

1.2 SUBMITTALS

A. See requirements Section 01300 - Submittals.

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- B. Submit a list of all irrigation equipment to be used, manufacturer's brochures, maintenance manuals, guarantees, and operating instructions.
- C. Approval by Landscape Architect of any items, alternate or substitute indicates only that the product or products apparently meet the requirements of the Drawings and Specifications on the basis of the information or samples submitted.

1.3 GUARANTEES AND REPLACEMENTS

The CONTRACTOR shall furnish a guarantee in accordance with the General Provisions and Special Conditions for a period of one year from the date of final acceptance, at the conclusion of the maintenance period by the CONTRACTOR. The entire system shall be guaranteed against defective equipment, materials, and workmanship. Repairs shall be made by the CONTRACTOR in a timely fashion at no expense to Owner. The guarantee shall include provisions for non-settling of the backfill in trenches which, if occurring, shall be corrected, including repairs and/or replacement of any material damaged thereby or there from, to the complete satisfaction of, and at no cost to the Owner.

1.4 SITE OBSERVATION BY LANDSCAPE ARCHITECT

- A. The Landscape Architect shall be notified a minimum of 48 hours prior to the requested field observation date.
- B. The Contractor shall request the presence of the Landscape Architect to observe the installation at the following stages of progress:
 - 1. Staking proposed tree locations prior to irrigation trenching.
 - 2. During pressure testing of mainline prior to backfilling.
 - 3. Upon completion of irrigation system and prior to planting to check coverage, adjustment and installation conformance to plans.
 - 4. Final walkthrough.

1.5 TESTING

- A. All PVC main and lateral lines shall be subjected to a pressure test of 150 PSI for a period of four hours. All testing shall be in the presence of the Landscape Architect. If leaks develop, repair leaking portions and repeat test until entire system is proven watertight. Approval shall be received before backfilling any trench. DO NOT COVER any lines until they have been inspected and approved.
- B. Wire Test:
 - 1. All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting to equipment. The

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minimum insulation resistance to ground shall be fifty (50) megohms. Any wiring not meeting these requirements shall be replaced.

2. If additional wire or tape is necessary repeat color sequence from beginning.
- C. Testing of Backflow Preventer Assembly shall be accomplished by a certified backflow tester. A certified tester is a person or organization authorized by the governing water authority or agency to perform testing on all backflow assemblies. The testing report certifying compliance with the authority or agency shall be submitted to the RESIDENT ENGINEER within ten calendar days effective from the date of testing. Report shall be an original report. Full compensation for performing the functional tests for backflow preventer assemblies shall be considered as included in the contract lump sum price paid for landscape irrigation and no additional compensation will be allowed therefore.

1.6 COVERAGE TEST

When the sprinkler system is completed, the CONTRACTOR, in the presence of the Landscape Architect, shall perform a coverage test to determine if the coverage of water afforded the lawn and planting areas is complete and adequate. The CONTRACTOR shall furnish all materials and perform all work required to correct any inadequacies.

1.7 RECORD DRAWINGS

- A. Before final acceptance of work by the Landscape Architect, the CONTRACTOR shall provide a record set of As-built Drawings showing the sprinkler system as installed. (See Special Conditions for further requirements.) Drawings shall indicate:
1. Any changes in location of items or type of equipment or installations from that shown on Drawings shall be so indicated on the Record Drawings.
 2. Valves shall be numbered and corresponding numbers shall be shown on the Record Drawings.
 3. All remote control valves, quick coupling valves and shut-off valves shall be located by measured dimensions. Dimensions shall be given to permanent objects and shall be to the nearest one-half foot.
 4. On the inside surface of the cover of the automatic controller, the CONTRACTOR shall prepare and mount a chart showing the valves and sprinkler heads serviced by that particular controller. All valves shall be numbered to match the operation schedule and the Drawings. Only those areas controlled by that controller shall be

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shown. This chart shall be a plot plan, entire or partial, showing buildings, walks, roads, and walls. A photo static print of this plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. This print shall be approved by the Landscape Architect and shall be secured to the inside of the cover. It shall be sealed in a watertight plastic cover.

Retrofitted systems: CONTRACTOR shall provide a reduced print of all changes to any existing irrigation systems affected by the retrofit. Prints shall be provided in conformance with above paragraph.

5. Immediately upon the installation of any buried pipe or equipment, the CONTRACTOR shall indicate on the Drawings the locations of said equipment. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, and driveways.
6. As-built Drawings shall be drawn on reproducible prints of the irrigation plans and detail sheet. Request reproducible from the Landscape Architect.
7. The following shall be dimensioned from two permanent points of reference (i.e. building corners, sidewalks, etc.):
 - Points of connection
 - Gate valves
 - Pressure line location
 - Controllers and control valves (including source of power)
 - Quick couplers
 - Routing of all direct burial control wire for irrigation
 - Size and location of irrigation control wire conduit
 - Size and location of all sleeving

1.8 GENERAL REQUIREMENTS

- A. Landscape mow-strips shall be in place before installation of sprinkler system.
- B. Scaled dimensions are approximate. Before proceeding with any work, the CONTRACTOR shall carefully check and verify all dimensions.
- C. Plan locations of heads, valves, controller and pipe lines are diagrammatic and indicate the spacing and relative locations of all installations. Minor modifications to locations may be made necessary by site conditions.

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- D. All lines shall have a minimum clearance of six (6) inches from each other, and from lines of other trades. Parallel lines shall not be installed directly over one another.
- E. Dielectric bushings shall be used in any connections with piping of dissimilar metal materials.
- F. Point of connection shall be approximately as shown on Drawings. The CONTRACTOR shall connect new underground piping and valves, and shall provide all flanges, adapters, or other necessary fittings for connection satisfactory to the Landscape Architect.
- G. Permission to shut off any existing, in-use water line must be obtained 48 hours in advance, in writing, from the RESIDENT ENGINEER. The CONTRACTOR shall receive instructions from the RESIDENT ENGINEER as to the exact length of time of each shut-off.
- H. CONTRACTOR shall be responsible for all existing irrigation and domestic systems in the project. Damage to existing irrigation or domestic system shall be required at the CONTRACTOR's expense to provide complete restoration of the damaged system back to its normal operational status.
- I. Care shall be used to avoid severing roots of existing trees. All trenching within 20' of trunk of existing trees to remain shall be done by hand methods, carefully tunneling under roots and routing pipe to avoid disturbing roots.
- J. If discrepancies are encountered between the plans and actual site conditions, or within the plans themselves, the CONTRACTOR shall contact the Landscape Architect for decision on appropriate changes.
- K. The CONTRACTOR is responsible for understanding the correct operation of all equipment. If operation is in doubt, contact manufacturer's representative for instruction.
- L. A separate plumbing permit and inspection will be required from the Building Inspection Department for the installation of the Irrigation system shown on these drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping: Pipe sizes shown are nominal inside diameter unless otherwise noted.
 - 1. Polyvinyl Chloride Pipe:
 - a) PVC Plastic Pressure Lines: For piping upstream of remote control valves and hose bibs. All three (3) inches and smaller shall be Type I, Grade 2, (Impact Modified), designated as PC

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1220, Class 315 (SDE 13.5), conforming to Commercial Standards (CS256-63). Pipe smaller than 2" diameter shall be Schedule 40.

- b) PVC Plastic Non-Pressure Lateral Lines: For piping downstream of remote control valves, Type I, Grade 2, (Impact modified) designated as PVC 1200, Class 200, (SDR21), conforming to Commercial Standards (CS256-63).
 - c) All sleeving installed under paving, roadways and walkways shall be Type I, Grade 2 (Impact modified) designated as PVC 1120, schedule 40, conforming to Commercial Standards (CS256-63). Size shall be two times diameter of pipe to be sleeved.
 - d) Identification: Furnish plastic pipe continuously and permanently marked with the following information: Manufacturer's name or trademark, size, class and type of pipe, working pressure at 73.4 degrees Fahrenheit, and National Sanitation Foundation (NSF) rating.
- 2. Brass pipe shall be IPS Standard Weight 125 pounds, 85% red brass.
 - 3. Galvanized steel pipe shall be Schedule 40 ASTM, A120-GIT threaded, coupled, and hot dip galvanized. Pipefitting shall be heavy pattern, banded, and galvanized malleable iron.
 - 4. Copper pipe shall be seamless, Type K, hard drawn tubing.

2.2 FITTINGS AND CONNECTIONS

- A. Polyvinyl Chloride Pipe Fittings and Connections: Type II, Grade I, Schedule 40, high impact molded fittings, manufactured from virgin compounds as specified for piping, tapered socket or molded thread type, suitable for either solvent weld or screwed connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable. Furnish fittings permanently marked with the following information: Nominal pipe size type and schedule of material, and National Sanitation Foundation (NSF) seal of approval. PVC fitting shall conform to ASTM D2464 and D2466.
- B. Brass Pipe Fittings and Connections: Standard 125 pound class, 85% red brass fittings and connections.

2.3 AUTOMATIC CONTROL WIRE

- A. Electric wiring running from controller to the remote control valves shall be solid, single conductor, copper wire, 4/64-inch insulation, 4/64-inch neoprene jacket, Direct Burial or equal, color code wires to each valve. Common wire

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shall be white. Provide two extra wires to furthest valve on each run. Wire gauge shall be 12-gauge minimum. Verify gauge of wire required with controller manufacturer's recommendations. Control wire coloration shall conform to the following:

Valve No.	Valve No.
1 Yellow	10 White/Black Stripe
2 Orange	11 Yellow w/Red Stripe
3 Blue	12 Blue w/Red Stripe
4 Black	13 Orange w/Red Stripe
5 Brown	14 Purple w/White Stripe
6 Purple	15 Brown w/White Stripe
7 Yellow w/Black Stripe	16 Yellow w/White Stripe
8 Orange w/Black Stripe	17 Blue w/White Stripe
9 Red w/Black Stripe	18 Red w/White Stripe

For controllers with more than 18 valves, the sequence shall be repeated.

B. Wire Splices:

1. Make with "Pen-Tite" or equal, epoxy, or PVC packaged kit recommended for underground use.
2. Seal stubbed out wires in similar manner.

2.4 AUTOMATIC CONTROLLER

- A. Each automatic controller shall be UL approved for indoor and outdoor installation, sized and mounted as noted on the Drawings, and electrically timed for automatically opening and closing automatic valves, as designated on plans.
- B. Controllers shall operate on single-phase, 110/120 volt, 60 cycles primary supply with 24/28 volt secondary output to solenoid valves and 40 VA transformer (UL approved) mounted inside case. Controllers shall have rain tight and dust proof steel case; UL approved for outdoor installation, and shall have all solid-state logic, fully programmable microcomputer with no moving mechanical parts.
- C. Controllers shall have the following features:
 1. Operate automatically, semi-automatically, and manually.

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2. Dual programming feature. Any station can be programmed into one or both programs. Stations can be grouped at any desired combinations on each program. Both programs can operate simultaneously, and are totally independent of each other.
3. Each station can be programmed to operate from 1 minute up to 9 hours and 59 minutes, with a minimum of one-minute increments.
4. Each program shall have up to 4 cycle starts (repeats) per day, and be capable of 8 repeats, utilizing each program.
5. Programmable to operate daily and on any selected day(s) of the week.

2.5 CONTROL VALVES

Remote control valves shall be of type, size and manufacturer as indicated on the irrigation legend.

2.6 BACKFLOW PREVENTER

Reduced pressure backflow preventer shall be of type, size and manufacturer as indicated on the irrigation legend and shall be of a type and manufacture approved by the local Water District.

2.7 SPRINKLER HEADS

- A. Lawn spray and turf and pop-up heads shall be constructed of bronze, brass, plastic, and/or stainless steel or a combination of the above, and shall conform to types and sizes determined by designations shown on the Drawings. Rotary heads shall have heavy-duty plastic casings or housings.
- B. Shrub spray, bubbler, and pop-up heads shall be constructed of bronze, brass, plastic, and/or stainless steel or a combination of the above as indicated on the Drawings.
- C. All sprinkler heads with similar functions shall be of common manufacture and shall be marked with the manufacturer's name and identification in a position where they may be identified without being removed from the system.

2.8 VALVE BOX

- A. For remote control valves and control wires: 9-1/2" x 16" x 11" green plastic meter box with lockable cover; maximum of 2 valves per valve box. Cover is to be hot branded with letter and number designation indicated on plans.
- B. For ball valve: 8-3/4" diameter x 12" round, green plastic valve box and lockable cover marked "Water".

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- C. For pull boxes: 9-1/2" x 16" x 11" plastic meter box with cover, hot branded "P.B."

2.9 QUICK COUPLING VALVE

Quick coupling valves shall be of type, size and manufacture as indicated on the irrigation legend, with resilient rubber cap.

2.10 BALL VALVES

Ball valves shall be of type, size and manufacturer as indicated on the irrigation legend.

2.11 TRACER WIRES

Tracer wires shall be No. 12, Type TW plastic coated copper wires.

2.12 CHECK VALVES

Check valves shall be spring type, adjustable P.V.C. sized to match line.

2.13 PRESSURE REGULATOR

Shall be manufactured of brass or bronze, and shall be capable of withstanding a cold water working pressure of 150 pounds per square inch. Each pressure regulator shall be preset to operate at the pressure indicated on plans.

2.14 GRAVEL

Clean pea gravel free from organic material, clay or loam; 1/4 to 1/2 inch in size.

2.15 BRICK

For valve box extensions, use standard red brick.

2.16 DRIP IRRIGATION EQUIPMENT

Shall be as noted on plans.

2.17 MISCELLANEOUS IRRIGATION EQUIPMENT

Shall be as noted and detailed on plans.

2.18 SPARE PARTS

- A. CONTRACTOR shall provide to the RESIDENT ENGINEER the following items at time of turnover of the project:
 1. Two wrenches for removing each different type of sprinkler head.
 2. Six loose keys for quick coupling valves.

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3. Five keys for opening and locking each automatic controller case.
4. Six-valve box cover keys of each type.
5. All manufacturers' warranties and instruction manuals associated with the irrigation equipment.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Locations on Drawings are diagrammatic and approximate only, and shall be changed and adjusted as necessary and as directed to meet existing conditions and obtain complete water coverage. Locate and stake all work and obtain approval of the Landscape Architect before any installation.
- B. The CONTRACTOR shall install and extend system as shown on the Drawings, and as necessary to carry out the intent of the Drawings and Specifications.
- C. The system is designed for the minimum operating pressure as shown at each point of connection. The maximum demand of gallons per minute is as specified. The Irrigation Contractor shall verify the available water pressure on the site prior to the start of installation.
- D. The CONTRACTOR shall not willfully install any equipment as shown on plans when it is obvious in the field that conditions exist that were not evident at the time these plans were prepared. Any such conditions shall be brought to the attention of the RESIDENT ENGINEER prior to any work or the Irrigation Contractor shall assume all responsibility for any field changes deemed necessary by the RESIDENT ENGINEER.
- E. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, CONTRACTOR shall make all necessary adjustment prior to finalizing project.
- F. To the extent possible, all irrigation lines and appurtenances are to be installed within the property line outside of public right-of-way, and at no time will an irrigation line cross a public street unless otherwise noted on plans. CONTRACTOR shall verify locations of all equipment prior to beginning work.
- G. The CONTRACTOR shall locate lines, valves, and other existing underground utilities prior to starting work and shall protect all existing utilities from damage during the course of construction. The CONTRACTOR shall obtain approval of the RESIDENT ENGINEER before digging trenches or interrupting utility service.
- H. The CONTRACTOR shall obtain permits and call for inspections as required by local codes and regulations.

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- I. All installations shall conform to local codes and accepted construction practices.
- J. Existing trees shall be protected and due care exercised to avoid damage to root systems.
- K. 120 volt electrical power source is to be provided by Electrical Contractor to the location for the automatic controller. Irrigation Contractor shall be responsible for final connection to equipment.
- L. Prior to commencing work, the contractor shall verify the existing Static Water pressure at the point of connection, and shall report any discrepancies with the pressure listed on the plans for each point of connection.

3.2 INSTALLATION OF IRRIGATION SYSTEM

A. General:

- 1. All irrigation system work including hydrostatic testing, coverage tests, preliminary operation tests of automatic controller, backfill, densification and compaction of trenches, and other excavation shall take place after finish grading and before planting.
- 2. During installation of pipe, fittings, valves, and other pipeline components, prevent foreign matter from entering system. Temporarily cap or plug open ends during cessation of installation operations.
- 3. Locate valves and other irrigation equipment in planting areas and locate piping along edges of planting areas except where infeasible to do so.
- 4. Coordinate irrigation work so that there will be no conflict with installation of utilities or work of other trades.
- 5. The CONTRACTOR shall be responsible for furnishing the labor and materials to connect to the service connections for water and electrical.
- 6. All irrigation piping and control wires under existing roadway, streets and walkways shall be placed in sleeves. (See Plans.)

B. Excavation and Backfilling of Trenches:

- 1. The CONTRACTOR shall excavate trenches, prepare sub-grade, and backfill true to line and grade with sufficient room for pipefitting, testing and inspecting operations. Do not backfill until the pipe system has been subjected to a hydrostatic test as specified.

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2. Trenching within "drip line" of existing trees shall be approved by the Landscape Architect prior to start of trenching operations. CONTRACTOR shall not sever roots over 1" in diameter. No mechanical trenching methods shall be permitted within the drip line of trees.
 3. Depth of trench:

Pressure line - 18" cover minimum (3" and smaller), 24" under paving

Non-pressure line - 12" cover minimum, 18" under paving
 4. Subsoil shall be free of all rocks over one (1) inch diameter, debris, and litter prior to use as backfill.
 5. Repair any leaks and replace all defective pipe or fittings until they meet test requirements. DO NOT COVER any lines until they have been inspected and approved by the Landscape Architect for tightness, quality of workmanship and materials.
 6. Backfill trenches, after approval of piping, with suitable and approved material, tamping soil around pipe. Thoroughly water, settling all trench fills until 90% compaction has been achieved.
 7. Backfill material shall be an approved soil, free from rocks and clods.
 8. All irrigation piping and control wires under existing roadways, streets and walkways shall be placed in sleeves. (See Plans.)
- C. Installation of Polyvinyl Chloride Pipe:
1. Because of the nature of plastic pipe and fittings, the CONTRACTOR shall exercise all caution in handling, loading, and storing, to avoid damage.
 2. The pipe and fittings shall be stored under cover until use, and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subjected to undue bending or concentrated external load to any point.
 3. Any pipe that has been dented or damaged shall be discarded until such dent or damaged section is cut and rejoined with a coupling. Pipe exposed to sunlight for more than 7 days shall not be installed.
 4. Trench depth shall be as specified above from the finish grade to the top of the pipe. The bottom of the trench shall be free of rocks, clods, and other sharp-edge objects.

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5. Pipe ends and fittings shall be wiped with MEK, or P-70 Primer or equal, before welding solvent is applied. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. All field cuts shall be beveled to remove burrs and excess before fitting and gluing together.
6. Pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction.
7. Center load pipe with small amounts of backfill to prevent arching and slipping under pressure. Leave joints exposed for inspection during testing.
8. No water shall be permitted in the pipe until inspections have been completed and a period of at least 24 hours has elapsed for solvent weld setting and curing.
9. Plastic to metal joints shall be made with plastic male adapters and metal nipple, hand tightened, plus one turn with a strap wrench.
10. Slip-fit plastic-to-plastic joints: Solvent weld using solvent recommended by pipe manufacturer only. Assemble per manufacturers' recommendations.
11. Threaded joints shall be fitted using Teflon tape.
12. Flush all debris out of pipe prior to installing heads.

D. Automatic Control Wiring:

1. Direct Burial Control Wire Sizes: As shown and specified. (See materials.)
2. Provide one (1) control wire and one (1) common ground wire to service each valve in system. Provide two (2) foot minimum expansion loop at each valve to permit removal and maintenance of valves.
3. Provide one (1) additional common (white) and one (1) additional control wire (red) to the last valve on each mainline run.
4. Install control wires at least 18 inches below finish grade and minimum four (4) inches from any pipe or fittings except at terminal points.
5. Wire Connections: Neutral, pilot, and spare wires shall be installed with a two foot (2') coiled excess wire length at each end enclosure. Each and every wire splice shall be soldered (using 60-40 solder) together, then encased in the waterproofed epoxy of the "Scotch-

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Pac; or "Pen-Tite" connectors. Wire splices shall be made only in valve or pull boxes.

6. Control Wire Splices: allowed only on runs of more than 300 feet. Install as for wire connections (above) using "Pen-Tite" or "Scotch-Pac" connectors.
7. Numbering and Tagging: Identify direct burial control wires from automatic valves to terminal strips of controller at terminal strip by tagging wire with number of connected valve. Valves shall be tagged with a metal band (non-corrosive) with valve and controller designation.
8. All wire connections or splices shall be made with "Pen-Tite" or "Scotch-Pac" connectors.
9. Control wires shall be bundled with electrical tape at maximum five-foot intervals.
10. Trench Marker: All direct burial wires shall be marked with a continuous yellow colored trench marker tape placed nine inches (9") below finished grade directly above the buried wires. Marker tape shall be equal to "Alarmatape" as manufactured by Paul Potter Warning Tape, Inc. Tape shall be four inches (4") wide.

E. Automatic Spinkler Controller:

1. Shall be installed in the location as shown on the Drawings and as directed. Connect electrical to stub out or outlet as shown on Drawings to conform to applicable electrical codes.
2. Connections to control wiring shall be made within the pedestal of the controller. All wire shall follow the pressure main insofar as possible.
3. Electrical wiring shall be in a rigid PVC plastic conduit from controller to electrical outlet. The Contractor shall be responsible for installing all wiring to the sub-panels or elsewhere as required, in order to complete this installation. A disconnect switch shall be included.
4. Controllers shall have a master switch. It shall be possible to operate each valve manually, independent of the clock or any other valve.
5. Rain shutoff device shall be installed per manufacturer's directions in a location open to receiving direct rainfall.
6. CONTRACTOR shall be responsible for programming controller to provide an appropriate amount of irrigation to assure appropriate soil moisture for planting area covered by valves. Modify

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programming to adapt to plant growth and weather conditions. Run-off and excessive moisture shall be eliminated.

F. Control Valves:

1. Install remote control valves in groundcover area whenever possible and/or as directed by Landscape Architect, with four (4) inches minimum between cover and top of flow control stem. Install a union type connection. Fit with plastic meter box and cover.
2. Adjust flow control and/or pressure regulating device on each valve so farthest sprinkler head served by valve operates at pressure recommended by head manufacturer, and so planted areas are supplied with uniform and even distribution of water.

G. Backflow Preventer:

Install backflow preventer with concrete footings, minimum 12 inches above grade per detail shown on Drawings. Provide pressure regulator and wye strainer with backflow preventer unit, types as indicated on plans, or approved equal.

H. Valve Boxes:

1. Valve boxes shall be set 3/4 inch above the final finish grade in the lawn area and 2 inches above grade in groundcover and shrub areas.
2. No more than two control valves shall be installed in any single valve box. For valves over 1", install no more than 1 valve per box.
3. All valve boxes shall have proper base support and extensions to prevent any settling of boxes. Fill in any settling adjacent to boxes.
4. All valve boxes shall be set parallel with each other and with structures or paving.

I. Ball Valves:

All ball valves shall be installed plumb with handles readily accessible. Valves shall be set in valve boxes.

J. Automatic Controller Enclosure:

Shall be installed per manufacturer's instructions and specifications, with concrete base.

K. Drip Irrigation:

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1. CONTRACTOR shall install a complete and functional system including valves, pressure regulators, filters, ball valves, PVC and/or poly piping, emitters, bug caps, distribution tubing, tubing stakes and access sleeves where required.
2. CONTRACTOR shall test the system to determine that the rate of application of the system matches the rating of the emitters (i.e., a 1 GPH emitter fills a one gallon container in one hour). Report results of test to Landscape Architect.
3. All drip irrigation equipment shall be installed as directed by manufacturer and as indicated in the plans.

L. Existing Irrigation Systems to be modified:

All new work on all existing irrigation systems to be modified shall conform to these specifications and the following:

1. Existing valves shall be inventoried, field photo surveyed, layouts and operating conditions recorded prior to any demolition on site. Existing valves removed during construction shall be replaced in a location where main laterals can be connected to existing sub-laterals per each respective system. Mainline supply shall be provided to all relocated existing valves.
2. Control wires shall be provided to relocated valves. Control wire for all valves shall be tested for continuity and repaired to operable condition.
3. All sprinklers controlled by valves on systems to be modified shall be adjusted to prevent over-spray onto walls and paving, and to promote 100% coverage of planting areas.
4. The existing systems shall be tested by the contractor for proper operation following completion of the work and prior to the irrigation substantial completion review.
5. All systems will be operated through the respective controller during the substantial completion review. CONTRACTOR is responsible for any corrections required to make the system fully functional and to achieve proper adjustment.

3.3 FIELD QUALITY CONTROL

A. Irrigation Pressure Testing:

1. No testing shall take place, nor shall any water be allowed into any system, before solvent manufacturer's recommending curing time has elapsed.

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2. A water pressure test shall be performed on all pressure mains and laterals before any couplings, fittings, valves, and the like are concealed.
 3. Provide plugs, valves, tanks, pumps, and accurately calibrated recording gauge as required for pressure testing.
 4. Test pressure lines and non-pressure lines under hydrostatic pressure of 150 lbs. per sq. in. watertight.
 5. Pressure mains shall be tested with all control valves to lateral lines open and the outlet side of valve capped. After the pressure main test, all valves shall be opened to test lateral lines.
 6. Sustain pressures in lines for not less than two hours. If leaks develop, replace joints and repeat test until entire system is proven watertight. Tests shall be observed by Landscape Architect prior to backfill.
 7. Upon completion of each phase of work, entire system shall be tested and adjusted to meet site requirements. Testing shall be completed and system operable prior to planting of all plants except specimen trees.
 8. At conclusion of pressure test, irrigation heads and quick coupling valves shall be installed in following manner: riser nearest the control valve, or gate valve, shall be uncapped, and full head of water shall be used for at least 30 seconds to flush out risers. Irrigation head or quick coupler valve shall then be placed in position on the riser. Cap on next closest riser shall be removed and preceding procedure used. Procedure shall continue until most distant riser in piping system or sprinkler battery has been flushed and quick coupling valve or irrigation head installed.
- B. Irrigation Coverage Testing: When sprinkler system is completed and prior to planting, perform coverage test in presence of Landscape Architect to determine if coverage is complete and adequate. Coverage test shall be performed after sprinkler heads have been installed and shall demonstrate that each section or unit in irrigation system is balanced to provide uniform and adequate coverage of areas serviced. Correct any deficiencies in system.
- C. Electrical Wire Testing: Before backfill material is placed over control wires in trench, test wires with megger for insulation resistance. Minimum insulation resistance to ground shall be 50 megohms. Replace any wires not meeting this requirement.
- D. Operational Testing:

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1. The performance of all components of the automatic control system shall be evaluated for manual and automatic operation.
2. Controller clocks shall be tested operationally for 14 days after complete installation of sprinkler system.
3. All necessary repairs, replacements, and adjustments shall be made until all equipment, electrical work, controls, and instrumentation are functioning in accordance with the CONTRACT DOCUMENTS.

3.4 ADJUSTING AND CLEANING

A. Irrigation System Adjustment:

1. After installation has been completed, make final adjustment of sprinkler system prior to Architect's and RESIDENT ENGINEER'S final review.
2. Check sprinklers for proper operation and alignment of spray throw.
3. Check each section of spray heads for operating pressure and balance to other section by use of flow adjustment on top of each valve.
4. Adjust irrigation heads to fully cover planting areas and not throw onto walks, buildings, or windows.
5. Adjust pressure regulator to achieve 10 P.S.I. more than minimum head operating pressure at highest system or highest and largest system.

B. Site Clean Up:

1. Upon completion of work, clean site to the satisfaction of the Architect and the RESIDENT ENGINEER.
2. Repair or replace any existing site improvements or systems damaged during course of work in this section.

3.5 POST INSTALLATION

- A. The CONTRACTOR shall be responsible for complete maintenance and protection of the Irrigation system until final acceptance of work is given by the Landscape Architect.
- B. The CONTRACTOR shall instruct the RESIDENT ENGINEER on all phases of operating and maintaining the irrigation system.

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- C. The CONTRACTOR shall turn over to the Landscape Architect all heretofore-specified special equipment and approved service manuals prior to final acceptance of work.
- D. The CONTRACTOR shall transmit to the Landscape Architect the Record Drawings.
- E. Clean Up. All work and all areas of work shall be left clean and free of excess material and debris at the end of the construction period.

3.6 MAINTENANCE SCHEDULE

- A. Provide maintenance of entire system for period of 90 days following pre-maintenance review and acceptance by Landscape Architect of planting and irrigation installation, including cleaning and adjustment of sprinkler heads and raising or lowering shrub heads to compensate for shrub growth.
- B. CONTRACTOR shall be responsible for damaged plant materials due to system failure during installation of plant materials and maintenance period.
- C. CONTRACTOR'S maintenance period shall not be terminated until the following conditions are satisfied and acceptable by Landscape Architect:
 - 1. Valves shall be wired to controller in same numerical sequence as indicated on drawings.
 - 2. Plastic sealed diagram of irrigation system are provided and mounted in each controller.
 - 3. All guarantees and warranties are submitted.
 - 4. Record drawings are submitted.
 - 5. System is fully operational, properly adjusted to provide uniform coverage, and operating automatically in a schedule suited to current seasonal climatic conditions.

**** END OF SECTION ****

SECTION 02831 - INDUSTRIAL ORNAMENTAL METAL FENCING

PART 1 -- GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall provide all labor, materials and appurtenances necessary for installation of permanent industrial ornamental steel fence system defined herein.
- B. The manufacturer shall supply a total industrial ornamental steel fence system. The system shall include all components (i.e., pickets, rails, posts, gates and hardware) required.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 01300 Submittals
 - 2. Section 02200 Earthwork
 - 3. Section 03310 Cast-in-Place Site Work Concrete
 - 4. Section 05500 Miscellaneous Metals

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. American Society for Testing and Materials
 - 1. A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM B117 Practice for Operating Salt-Spray (Fog) Apparatus,
 - 3. ASTM D523 Test Method for Specular Gloss.
 - 4. ASTM D714 Test Method for Evaluating Degree of Blistering in Paint.
 - 5. ASTM D822 Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
 - 6. ASTM D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

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7. ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
8. ASTM D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
9. ASTM D3359 Test Method for Measuring Adhesion by Tape Test.
10. ASTM F2408 Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.4 SUBMITTALS

- A. Manufacturer's catalog data showing all fencing components and details of fencing, gates, tension bands and bars, sleeves, ties, connectors, bolts, and color palette.
- B. Certificates of Compliance from the manufacturer attesting that all materials meet the requirements specified herein.
- C. A layout drawing showing the final spacing of posts and locations of gates, corner and end posts, and details for post mounting plates.
- D. Provide details for gate door frames, door latches, stop posts, lock assemblies, and hinges.
- E. The manufacturer's submittal package shall be provided prior to installation.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE AND HANDLING

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damages 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. Refer to project specific requirements for storing materials on-site.

SECTION 02831 - INDUSTRIAL ORNAMENTAL METAL FENCING

PART 2 -- MATERIALS

2.1 MANUFACTURER

- A. The industrial ornamental 3-rail steel fence system shall be Aegis II - Invincible as manufactured by Ameristar Fence Products, Inc., or equal.

2.2 FENCING MATERIALS

- A. Steel material for fence framework (i.e. tubular pickets, rails, posts and mounting brackets), shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 50,000 psi (344 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 fence pickets shall be 1" square x 14 Ga. tubing. The fence system shall have an internal retaining rod, picket-to-rail joining system. The cross-sectional shape of the rails shall have outside cross-section dimensions of 1.75" square and a minimum thickness of 14 Ga. Picket holes in the rail shall be spaced 4.72" o.c., or as required by code. Picket retaining rods shall be 0.125" diameter galvanized steel. Posts shall be a minimum of 3" square x 12 Ga. High quality PVC grommets shall be supplied to seal all picket-to-rail intersections.

2.3 FABRICATION

- A. Pickets, rails and posts shall be precut to specified lengths. Rails shall be prepunched to accept pickets. Pickets shall be predrilled to accept retaining rods.
- B. Grommets shall be inserted into the prepunched holes in the rails and pickets shall be inserted through the grommets so that predrilled picket holes align with the internal upper raceway of the rails (Note: This can best be accomplished by making an alignment jig). Retaining rods shall be inserted into each rail so that they pass through the predrilled holes in each picket.
- C. 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 (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a zinc-rich thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 - 4 mils (0.0508 - 0.1016 mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 3 mils (0.0762 mm). The color shall be Black. The

SECTION 02831 - INDUSTRIAL ORNAMENTAL METAL FENCING

stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.

- D. Completed sections (i.e., panels) shall be capable of supporting a 600 lb. load applied at midspan without permanent deformation. Panels shall be biasable to a 25% change in grade. Greater slopes may require special assembly.
- E. Swing gates shall be fabricated using the same fence panel material and gate ends having the same outside cross-section dimensions as the rail. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined either by welding or by the same retaining rod process used for panel assembly.
- F. Gates shall have diagonal tension cables with tighteners and lock/latch assemblies as shown on the construction drawings.

2.4 POST CONCRETE

- A. Post concrete shall be 500-C-2500 per SPPWC 201-1.1.2. Grout shall be one part Portland cement to three parts clean, well-graded sand, with minimum amount of water added to produce a workable mix.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 INSTALLATION

- A. Fence posts shall be set in accordance with the spacing shown on the construction drawings, plus or minus 1/2", depending on the nominal span specified. Gateposts shall be spaced according to the gate openings specified in the construction drawings.
- B. The "Concrete" sections of this specification shall govern post base material requirements.
- C. Fence posts attached to concrete structures using mounting plates shall be constructed as shown on drawings and coated as stated in section 2.02 above.
- D. Fence panels shall be attached to posts using mechanically fastened panel brackets supplied by the manufacturer. When cutting rails immediately seal the exposed steel surfaces by 1) Removing all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply

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2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate manufacturer's warranty. CONTRACTOR shall use all parts and components from the same manufacturer.

3.3 GATE INSTALLATION

- A. 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 manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.4 CLEANING

- A. The CONTRACTOR shall clean the jobsite of excess materials.
- B. Soil from post-hole excavations shall be scattered uniformly away from posts.
- C. Removed concrete and/or asphalt paving shall be removed and disposed of by CONTRACTOR.

TABLE 1 – 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, 02244, 0523 (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).

**** END OF SECTION ****

SECTION 02900 - LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all services, labor, materials, and equipment necessary for the complete installation of all landscape planting as shown on the Drawings and as specified herein. The section includes:

1. Soil preparation
2. Shrubs and groundcovers
3. Planting and backfill mixes
4. Landscape header and gravel mulch
5. Mulch and planting accessories
6. Maintenance

B. RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 02050 Demolition
3. Section 02100 Site Preparation
4. Section 02200 Earthwork
- 5.
6. Section 02760 Compact Proprietary Biofiltration BMPs
7. Section 02768 Permeable Interlocking Landscape Paving
8. Section 02810 Irrigation Systems
9. Section 03310 Cast-in-Place Site Work Concrete

1.2 SUBMITTALS

A. See requirements in Section 01300 - Submittals.

SECTION 02900 - LANDSCAPE PLANTING

- B. CONTRACTOR shall submit to Landscape Architect a list of soil amendment, fertilizers, plant materials, seed and sod with Specifications, suppliers, and quantities of each.
- C. CONTRACTOR shall submit photographs of actual plant specimens for all plants 15 gallon and larger for approval by Landscape Architect 15 days prior to delivery to site. Plants smaller than 15-gallon size will be reviewed for conformance to specifications at the site by the Landscape Architect.
- D. Approval by Landscape Architect of any item, alternate or substitute indicates only that the product or products apparently meet the requirements of the Drawings and Specifications on the basis of the information or samples submitted.

1.3 GUARANTEES AND REPLACEMENTS

- A. Trees shall be guaranteed to remain healthy for one year from date of final acceptance at end of maintenance period. Lawns, shrubs, vines, and groundcovers shall be guaranteed to remain healthy and vigorously growing for three months from the date of final acceptance of project. This guarantee shall not apply to damage or death resulting from negligence or neglect by parties other than the CONTRACTOR as determined by the Landscape Architect.
- B. All plants found to be dead and not in a vigorous condition noted within the Guarantee Period shall be replaced within 14 days of written notification by the Landscape Architect.
- C. Plants used for replacement shall be the same size, species and variety as specified in the plant list. They shall be furnished, planted, and fertilized as originally specified, without cost to the Owner.

1.4 PRODUCT HANDLING

- A. Delivery:
 - 1. Deliver commercially processed or packaged material in original unopened containers.
 - 2. Protect plant materials from sun, heat, wind, disease, damage, and frost during transportation.
 - 3. Protect plant root balls during transportation.
 - 4. Deliver plant materials with legible identification labels.
 - 5. Notify Landscape Architect of delivery at least 24 hours in advance to provide for observation of materials upon arrival at site.

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B. Storage:

1. Store plant materials in shade and protect from heat, sun, wind, disease, damage, and frost during storage, however, plant materials to be planted in sunny locations shall be stored in sun.
2. Maintain and protect plant materials not to be planted within four hours.
3. Do not store plant materials in total darkness for more than 24 hours.
4. Plant materials shall not be allowed to dry out.
5. The CONTRACTOR'S on-site plant storage area shall be approved by the Landscape Architect prior to the delivery of any plant materials. Any plants determined by the Landscape Architect to be wilted, broken, or otherwise damaged shall be rejected at any time during the project, whether in the ground or not. All plants shall be handled by their containers. Any plant that has been handled by its trunk or stem shall be rejected. All rejected plants shall be removed from the site immediately.

C. Handling:

1. Protect plant root balls at all times during handling.
2. Do not drop plant materials.
3. Do not pick up container plants by stems or trunks.

D. Acceptance at Site:

1. Request Landscape Architect to review plant materials upon delivery to site.
2. Any plant material found unacceptable by Landscape Architect shall be immediately removed from site at CONTRACTOR'S expense.
3. Each group of plant materials delivered on site shall be labeled clearly as to species and variety. All patented plants (cultivars) required by the plant list shall be delivered with a proper plant patent attached.
4. Plants shall be in accordance with the California State Department of Agriculture Regulations for Nursery Inspections, Rules and Grading.

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5. The Landscape Architect is the sole judge as to acceptability of each plant. Vigorous, healthy well-proportioned plants are the intent of this specification. Plants that are even moderately "overgrown," or are showing signs of decline or lack of vigor are subject to rejection. The size of the plants will correspond with that normally expected for species and variety of commercially available nursery stock, or as specified in the special conditions or drawings. Plants larger in size than specified may be used with the approval of the Architect, but the use of larger plants will make no change in contract price.
 6. All plants not conforming to the requirements herein specified shall be considered defective, and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site and replaced with new plants by the CONTRACTOR at his expense.
- E. Protection Prior to Installation: Maintain and protect plant material until time of actual planting.
- F. Right to Changes: The Landscape Architect reserves the right to change the species, variety, and/or sizes of plant material to be furnished, provided that the cost of such plant changes do not exceed the cost of plants in the original bid, and with the provision that the CONTRACTOR shall be notified, in writing, at least thirty (30) days before the planting operation has commenced.

1.5 SITE OBSERVATION BY LANDSCAPE ARCHITECT

- A. The Landscape Architect shall be requested to be present at the site with at least 48 hours notice prior to the requested field observation date.
- B. The CONTRACTOR shall request the presence of the Landscape Architect to observe the installation at the following stages of progress:
1. Staking proposed tree locations, prior to irrigation trenching, and review special measures to be taken to protect existing trees.
 2. Review of tree specimens and location prior to planting.
 3. Review of shrub and groundcover specimens and location prior to planting.
 4. Final review of completed installation and approval to begin maintenance (substantial completion review).
 5. Completion of maintenance period and turnover to RESIDENT ENGINEER.
- C. Also see Special Conditions.

1.6 MAINTENANCE SCHEDULE

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- A. The Maintenance Period begins on the first day after all work on the project is complete, checked, accepted, and written approval from the Landscape Architect is given to begin the Maintenance Period, and shall continue thereafter for not less than 90 continuous calendar days.
- B. The CONTRACTOR shall continuously maintain all involved areas of the Contract during the progress of the work and during the Maintenance Period until the Final Acceptance of the work by the Landscape Architect.
- C. The CONTRACTOR shall provide complete landscape maintenance of all areas per section 3.08 of these specifications. The work shall include, but not be limited to watering, litter control, weed control, stake repair, cultivating, repair of irrigation systems, and control of diseases and pests.

1.7 GENERAL REQUIREMENTS

- A. The term "planted area" shall mean all areas to be planted, broadcasted, and/or sown with trees, shrubs, groundcovers, and seed.
- B. All rock and other growth or debris accumulated throughout the duration of the project shall be removed from the site by the CONTRACTOR.
- C. Prior to excavation for planting or placing of plant materials, the CONTRACTOR shall locate all underground utility lines still in use and take proper precautions to avoid damage to such improvements. In the event of a conflict between such lines and plant locations, the CONTRACTOR shall notify the Landscape Architect who shall arrange for the relocation of one or the other. The CONTRACTOR assumes all responsibility for making any and all repairs for damages resulting from work as herein specified.
- D. Grading and soil preparation work shall be performed only during the period when beneficial and optimum results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction, spreading and grading operation shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.
- E. CONTRACTOR shall coordinate all drainage work with all other trades. Established site drainage shall be maintained by CONTRACTOR during all phases of landscape construction.
- F. Grade all areas by filling and/or removing surplus soil as needed to ensure proper grades and drainage as indicated on the plans. Unless otherwise noted, finish grades shall be below hardscape as follows: 1/2" for groundcover areas, 1/2" for lawn areas.

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- G. All undulations and irregularities in the planting surfaces resulting from tillage, rototilling, and all other operations, and all ridges and rises which would affect the maintenance of any lawn areas and which are visually evident, shall be leveled and floated out before planting operations are initiated.
- H. Final finish grades shall insure positive drainage of the site with all surface drainage away from buildings, walls, and toward roadways, drains, and catch basins.
- I. Final grades shall be acceptable to the Landscape Architect before planting operations will be allowed to begin.
- J. The above conditions shall also apply to the final finish grade at the time of project completion.
- K. Actual planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practice as approved by the Landscape Architect.
- L. All scaled dimensions are approximate. Before proceeding with any work, the CONTRACTOR shall carefully check and verify all dimension and shall immediately inform the Landscape Architect of any discrepancy between the Drawings and/or Specifications and actual conditions.
- M. Quantities for plant materials are shown for convenience only, and not guaranteed. Contractor shall check and verify count and supply sufficient number to fulfill intent of Drawings. Plant symbol quantities shall take precedence over legend quantities and callouts.
- N. Protection of existing trees, shrubs, and groundcover (See Special Conditions).
- O. Excavation adjacent to existing trees and shrubs: Where it is necessary to excavate in close proximity to existing trees and shrubs, all possible caution shall be exercised to avoid injury to roots and trunk. Excavation close to trees shall be by hand, tunneling under roots 2" and larger in diameter, and shall be only on the approval of the Landscape Architect. Within 24 hours, CONTRACTOR shall paint cut roots of trees to remain on-site. Where this is not possible, CONTRACTOR shall keep the side of excavation adjacent to tree shaded with moist burlap or canvas.
- P. Existing Trees and Shrubs:

Identify and protect from damage all individual plants and areas of planting to remain by appropriate means. CONTRACTOR shall provide equivalent size replacement plants in the event that the death or decline of existing plants to remain is attributable to the CONTRACTOR'S negligence.

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All plants to remain on-site shall be watered and irrigated as necessary during the entire construction contract.

The pruning and trimming of the limbs and roots of plant materials to remain within the project scope shall be done by tradesmen experienced in this type of work. The removal of any limbs, branches and roots shall be done only after conferring with the Landscape Architect. All limbs 1-1/2" or larger in diameter shall be sealed with approved sealant after cutting.

Plants to be removed, boxed and set aside for future use shall be watered and maintained by the CONTRACTOR in a healthy condition until replanted or until the end of maintenance period.

- Q. Shrub and Tree Samples: Typical samples, three each of all varieties and sizes of all plant materials, shall be submitted for inspection approval by the Landscape Architect at the site a minimum of fifteen days prior to planting operations. Approved samples shall remain on the site and shall be maintained by the CONTRACTOR as standards or comparison for plant materials to be furnished. Samples will be incorporated into the work. Photos of representative plants with scale and dimensions may be substituted with approval of the Landscape Architect.
- R. Rejection and Substitution: All plants not conforming to the requirements herein specified shall be considered defective, and such plants, whether in place or not, shall be marked as rejected and replaced with acceptable plant materials at the CONTRACTOR'S expense. The plant materials shall meet all applicable inspections required by law. All plants shall be of the species, variety, size, age, flower color and condition as specified herein and/or as indicated on the Drawings. Under no condition will there be any substitution of plant species, variety, or reduced sizes for those listed on the accompanying Drawings, except with the expressed written consent of the Landscape Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Soil Amendment and Fertilizer:
 - 1. Soil conditioner shall be a composted product certified by the U.S. Composting Council's Seal of Testing Assurance Program or an approved equal. Compost shall comply with the following requirements:
 - a. Organic Material Content shall be 35% to 75% by dry weight.
 - b. Physical contaminants (manmade inert materials) shall not exceed 1% by dry weight

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- c. pH shall be between 6.0 and 8.0
- d. Soluble Salt Concentration less than 10 dS/m (Method TMECC 4.10-A, USDA and U.S. Composting Council)
- e. Maturity (seed emergence and seedling vigor): greater than 80% relative to positive control (Method TMECC 5.05-A, USDA and U.S. Composting Council)
- f. Stability (Carbon Dioxide evolution rate): less than 8 mg CO₂-C per g OM per day (Method TMECC 5.08-B, USDA and U.S. Composting Council)
- g. Moisture: 40%-50% wet weight basis.
- h. Select Pathogens: Pass US EPA Class A standard, 40 CFR Section 503.32(a).
- i. Trace Metals: Pass US EPA Class A standard, 40 CFR Section 503.13, Tables 1 and 3.
- j. Within gradation limits in Table 212-4.1.2 (ASTM D 422 sieve analysis or approved equivalent)

Table 800-1.2.4 (A) Compost Gradation Limits

Sieve Size	Percent Passing (by weight)
1 inch	99 to 100
½ inch	90 to 100
¼ inch	40 to 90
No. 200	2 to 10

- 2. Gypsum shall be a commercially processed and packaged agricultural grade gypsum (CaSO₄, H₂O) calcium sulfate product - 92% purity. 100% shall pass a 10 mesh screen, 92.5% shall pass a 100 mesh screen. Chemical reaction will remove sodium particles and loosen heavy clay soils through electrochemical action. Control of dust during application is mandatory. Product shall be U.S. Gypsum, Domtar, Bandini, U.S. Gypsum or approved equivalent.
- 3. Fertilizer (pre-plant 12-12-12) shall be long-lasting, controlled release, uniform in composition, free-flowing suitable for application with approved equipment, and shall contain the following minimum available percentages by weight of plant food:

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- a. Nitrogen 12% minimum
 - b. Phosphorous Pentoxide 12% minimum
 - c. Potassium Sulfate 12% minimum
4. Fertilizer (12-4-6) shall be organic based, long lasting, non-burning, slow release, free-flowing uniform in composition, suitable for application with approved equipment, and shall contain the following minimum available percentages of weight of plant food with trace minerals of 2% iron (expressed metallic) and 7% sulfur (elemental), Zinc .15% and Manganese .15%.
- a. Nitrogen 12% minimum
 - b. Phosphoric Acid 4% minimum
 - c. Potash 6% minimum
5. Planting tablets shall be tightly compressed chip type commercial grade planting tablets, of varying sizes with the following available percentages by weight of plant food:
- a. Nitrogen 20%
 - b. Phosphoric Acid 10%
 - c. Potash 5%
6. Iron sulfate shall be expressed as metallic, derived from sulfate (FE SO₄ H₂O). Product shall contain a minimum analysis of 20.0% Ferrous Sulfate and Heptahydrate 99%, and shall be free flowing crystals in powder form. Iron is required for the formation of chlorophyll in plant cells and deters iron chlorosis symptoms of plants.
7. Soil sulfur shall contain 90% sulfur and shall be a granular, degradable agricultural sulfur fertilizer that can be used as a source of plant nutrient sulfur or as an amendment for correction of high soil PH. Product shall be granular form to improve dust control during spreading.
8. Soil conditioner shall be 'Sarvon' liquid soil conditioner by Butler's Mill, or approved equivalent.
- B. Planting Backfill:
- 1. Planting backfill shall be a thoroughly blended mixture of soil and soil amendments thoroughly mixed at one location on project site and distributed evenly. Prior to ordering materials, verify components with Landscape Architect for any changes in

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conformance with the soil test results. Mix shall consist of the following:

Existing Soil	3 part
Soil Conditioner (Compost)	1 part
Iron Sulfate	1 lb/c.y. of mix
Soil Sulfur	1 lb/c.y. of mix
Gypsum	10 lbs./c.y. of mix
Fertilizer (12-12-12)	1 lbs./c.y. of mix

C. Plant Materials:

1. Immediately upon award of contract for work in this section, locate and purchase or hold for purchase all plant materials required.
2. Nomenclature: The scientific and common names of plants herein specified conform with the approved names given in "A Checklist of Woody Ornamental Plants of California", published by the University of California, College of Agriculture. See list of plant materials on Drawings.
3. Plant material shall be per the California State Department of Agriculture Regulations for Nursery Inspections of Rules and Grading. All plants shall be vigorous, healthy, of normal growth, free from disease, insects and insect eggs, and meet the measurements specified. Nursery tags must be submitted to the Landscape Architect.
4. All plants shall have a growth habit normal to the species and shall be symmetrical, typical for variety and species, sound, healthy, vigorous and free from insect pests, plant diseases, sun scalds, fresh bark abrasions, excessive abrasions, or other objectionable disfigurements.
5. Container stock (1 gal, 5 gal, 15 gal.) shall have grown in containers for sufficient time to permit full rooting within the container to bind the soil but not so long as to create a root-bound condition. No container plants that have cracked or broken balls of earth, when taken from the container, shall be planted. No plants with damaged roots, broken root balls, or root bound, when taken from container shall be planted.

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6. Groundcover plants shall be healthy, vigorous, rooted cuttings grown in flats or 1 gal. cans until transplanting. See plant material legend on Drawings.
 7. Pruning shall not be done prior to delivery except by approval of Landscape Architect.
 8. Inspection of plant materials required by City, County or State authorities, shall be the responsibility of the Contractor, and where necessary, permits or certificates shall have been secured prior to delivery of trees to site.
 9. Plants shall be subject to inspection and approval or rejection at the project site at any time before or during progress of work, for size, variety, condition, latent defects, and injuries. Rejected plants shall be removed from the project site immediately.
 10. Substitutions will not be permitted except if proof is submitted that any tree specified is not obtainable, then a proposal will be considered for use of the nearest equivalent size or variety and cost. All substitutions are subject to Landscape Architect's written approval.
 11. Quantities shall be furnished as needed to complete work chosen on the Drawings.
 12. Identify plant species or varieties correctly on legible, weatherproof labels attached securely thereto before delivery to job site. There shall be a minimum of one labeled plant for each 5 plants in a lot.
 13. All plants shall be reviewed and approved for acceptable size and quality by Landscape Architect prior to planting.
 14. Photos of all trees 15 gallons and larger shall be submitted to Landscape Architect for approval a minimum of 15 days prior to delivery of the plants to the site. The Landscape Architect reserves the right to reject any plant species upon conducting a physical inspection after delivery to the site.
 15. The Landscape Architect reserves the right to reject any plant material found to be defective or not in conformance with plans and specifications.
- D. Hydro-seeding Materials:
1. 12-12-12 fertilizer.
 2. Cellulose fiber mulch - Weyerhaeuser - "Silva-Fiber" or equal.

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3. Humectant – “Sarvon” by Butler’s Mills, or equal.
 4. Seed Mix as specified on the Drawings.
 5. Organic soil binder: Guar Gum (min. 90% active ingredient), “M-binder”, “Bio-Binder”, or equal.
- E. Hydro-seeding Components per Acre:
- | | |
|-----------------------|----------------------------|
| 12-12-12 Fertilizer | 400 lbs. per acre |
| Cellulose fiber mulch | 2,000 lbs. per acre |
| Organic soil binder | 130 lbs. per acre |
| Humectant | 50 lbs. per acre |
| Seed mix | (As specified on Drawings) |
- F. Herbicides:
1. Post emergent herbicide
 - a. Post-emergent herbicide shall be ‘Round-up’ by Monsanto Corporation, or approved equal.
 2. Pre-emergent herbicide
 - a. Pre-emergent herbicide for shrub areas, groundcover areas (planted from flats), and decomposed granite areas shall be Treflan, Surflan, Eptan, or approved equal.
- G. Bark Mulch:
1. Shall be shredded bark mulch and shall be composed of cedar, fir or pine shredded bark or equal commercial wood chip products. Average dimensions shall be 1 ½ to 3” in length and ½ to 1” in thickness. Submit two samples for approval by the Resident Engineer/Landscape Architect prior to installation.
 2. Submit a physical sample to the Landscape Architect for approval.
- H. Aggregate Mulch: Hard, durable aggregates, washed free of loam, sand, clay, and other foreign substances or debris. Aggregate mulch shall be of following type(s), composition(s), size range(s), and color(s), and shall match the representative samples as acquired by the Landscape Architect.
1. “Aggregate Mulch”.
 - a. Material and Supplier:
 1. ‘Baja Cresta Grey’ - 3/4” crushed rock, by Decorative Stone Solutions, (800) 699-1878.

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2. or equal, as approved by the Landscape Architect or RESIDENT ENGINEER. Match approved referee sample, as acquired by the Landscape Architect, to compare for material, color, texture, size, and other characteristics relating to aesthetic effects.
 - b. Provide in an adequate and sufficient quantity at areas indicated per the CONTRACT DOCUMENTS, and to the satisfaction and approval of the Landscape Architect or RESIDENT ENGINEER.
- I. Composite Wood/Polymer Lumber Edging Header:
1. Material: An equal blended composition of waste wood fiber and reclaimed plastic, molded and formed into typical dimensional lumber. Characteristics of the material include UV resistance; low moisture absorption to 4%; chemical and pest resistance; free from splintering, splitting, cracking and warping effects; low thermal expansion and contraction; and excellent paint and stain adhesion.
 2. Size: Composite Wood/Polymer Lumber Edging Header shall be in the location and orientation as indicated in the Contract Drawings. Minimum length of each member of the material shall be 16'-0".
 - a. 2 x 4 x 16'-0".
 3. Color:
 - a. Woodland Brown.
 4. Splices: Composite wood/polymer lumber, same as the Edging Header, not less than twelve inches (12") in length. Attach Splices to Edging Headers with hot-dipped galvanized ceramic-coated wood deck screws (#12, 3" long, minimum six (6) screws per Splice). Pre-drill all holes at 3/4 of the diameter of the actual screw. Place Splices on ground cover side of Edging Header, at 1/2" below the top of the Edging Header.
 5. Stakes: Composite wood/polymer lumber, same material as the Edging Header, cut to size of 2" x 3" x 12" inches long in nominal, with one (1) tapered/pointed end to penetrate soil. Anchor Stakes to Edging Header with hot-dipped galvanized ceramic-coated wood deck screws (#12, 3" long, minimum two (2) screws per Stake). Space Stakes at equal intervals not less than 3'-0" on-center, and at all directional changes. Pre-drill all holes at 3/4 of the diameter of the actual screw. Place Stakes on ground cover side of Edging Header, at 1/2" below the top of the Edging Header.

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PART 3 - EXECUTION

3.1 INSPECTION

- A. Carefully verify quantities of plants to be installed.
- B. Verify that irrigation system has been installed, tested, adjusted, in proper working order, and reviewed prior to beginning planting operations.
- C. Carefully verify all dimensions at site, as drawings are diagrammatic.
- D. Report in writing any errors or discrepancies in or between the drawings, specifications or planting lists to Landscape Architect for adjustment before proceeding with work.
- E. Upon failure to notify Landscape Architect of discrepancies or errors between drawings and existing conditions, supply all items indicated on drawings without compensation for unnecessary items.
- F. Coordinate planting work so that there shall be no conflict with installation of utilities, construction, or other site improvements.
- G. Inspect trees, shrubs and groundcover plants for injury or insect infestation and palms and shrubs for improper pruning prior to installation.
- H. Do not commence planting until plant material deficiencies are corrected or plants are replaced.
- I. Verify that irrigation systems installed and operable prior to landscape backfilling and planting operations.

3.2 GENERAL

- A. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practice, as approved by the Landscape Architect. No planting shall be done in any areas until it has been satisfactorily prepared in accordance with these specifications. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be the sole judgment of the Landscape Architect and their decision shall be final. The CONTRACTOR shall obtain approval from the Landscape Architect of planting pits before planting operations shall begin. If the soil moisture level is found to be insufficient for planting, all planting pits shall be filled with water and allowed to drain before starting planting operations. No more plants shall be distributed in the planting area on any day than can be planted and watered on that day. All plants shall be planted and watered as herein specified immediately after the removal of the containers. Containers shall not be cut prior to placing the plants in the planting area.

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B. Protection:

1. Protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of work and maintenance period.
2. Protect concrete paving and headers from staining due to contact with wet nitrogen stabilized redwood sawdust and drainage, or contact with chelated iron; correct any stained concrete.

3.3 WEED CONTROL

A. Post-emergent weed control

Prior to planting, eradicate all weeds within the limits of work in the following order:

1. Irrigate a minimum of twice each day for approximately 10 minutes each watering time for a period of 14 calendar days to moisten soil and germinate weed seeds.
2. Apply Round-Up post-emergent herbicide according to manufacturer's recommendations. Take care to protect existing plant material which is to remain as shown on the Plans.
3. Wait the required period for post-emergent to take effect (approximately 7-14 days).
4. Physically remove all weeds dead or alive within the limits of work.

B. Pre-emergent herbicide:

When pre-emergent herbicide is determined to be necessary due to potential for heavy weed infestations, apply herbicide per the manufacturer's instructions to bark mulched areas and groundcover areas planted from flats after areas are planted. Verify that the product is designed to be applied in areas of the desirable plant species without damage. Do not apply to hydro-seeded areas.

3.4 SOIL CONDITIONING AND FERTILIZING

- A. Grub and clean all planting areas, removing all weeds, debris, and rocks larger than 2" in diameter from the site. All planting areas shall be thoroughly tilled and loosened to a depth of twelve (12) inches by approved method. Do not till near existing trees if roots are encountered.
- B. After all planting areas meet the finish grades per grading plan, the following rates of soil conditioning and amendment materials or as modified by the soils report, shall be evenly spread over all planting areas and worked into the soil:

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1. Soil amendments for all planting areas less than 3:1 in steepness:

Soil conditioner	4 cu. yds. /1,000 sq. ft.
Gypsum	100-lbs./1,000 sq. ft.
12-12-12 Fertilizer	10-lbs./1,000 sq. ft.
Iron Sulfate	5-lbs./1,000 sq. ft.
Soil Sulfur	10-lbs./1,000 sq. ft.

Amendments shall be thoroughly tilled and blended into the existing soil to a depth of six (6) inches by approved methods.

2. Soil amendments for sloped planting areas 3:1 or greater in steepness:

Gypsum	80-lbs./1,000 sq. ft.
12-12-12 Fertilizer	10-lbs./1,000 sq. ft.
Iron Sulfate	5-lbs./1,000 sq. ft.
Soil Sulfur	10-lbs./1,000 sq. ft.

Amendments shall be raked into soil surface without disturbing the compaction of the slope.

- C. The thoroughness and completeness of the incorporation of the soil conditioners/amendments shall be acceptable to the Landscape Architect.

- D. Deep Water Leaching:

1. After complete installation and testing of the irrigation system, all on-grade areas shall be deep water leached, compacted, and settled by continuous application of irrigation water until the soil has received a minimum of 8" of water.
2. After leaching operation, 3 soil samples shall be taken by CONTRACTOR per Landscape Architect's direction and given to a reputable soil laboratory for testing. Soil test shall meet the following requirements:

EC -	Maximum 3.00
PH -	Maximum 7.50 Minimum 6.00

3. Reapplication of soil amendment and leaching operation shall be repeated by CONTRACTOR if tests show a negative result. Expense of test, reapplication or soil amendment and leaching operation shall be borne by Contractor.
4. Fill in all depressions, voids, erosion scars, or settled trenches generated by the deep leaching with conditioned soil, leaving a final

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finish grade smooth and even to conform with the finish grading plan.

5. No planting shall be installed until approval has been given by the Landscape Architect.

E. Percolation Test:

1. Prior to installing plants, CONTRACTOR shall perform a minimum of three percolation tests in representative areas of the site to verify acceptable natural drainage for planting pits. Test shall be performed as follows:

Dig a hole 2' x 2' x exactly 24" deep.

Fill with water to top and cover with plywood and barricade to protect pedestrians. Allow to drain and fill to the top again.

Make daily observations noting the depth of water each day.

Report to the Landscape Architect the length of time that the water takes to drain completely from each hole. Based on this test, the Landscape Architect will make a determination on whether additional drainage measures will be required for container plantings.

3.5 FINISH GRADING

- A. Finish grading shall be as indicated on Civil Engineer's drawings.
- B. Finish grades shall be measured at the final water compacted and settled surface grades and shall be within plus or minus 0.1 foot of the spot elevations.
- C. Finish grades shall be measured at the top surface of surface materials. Grade shall be 1/2" below walks.
- D. The top six (6) inches of all lawn area shall be completely free of rocks and clods larger than one (1) inch in their largest dimension, and all other growth or debris shall be removed from the site.
- E. All undulations and irregularities in the planting surfaces resulting from tillage, rototilling, and all other operations, and all ridges and rises which would affect the maintenance of any lawn areas and which are visually evident, shall be leveled and floated out before planting operations are initiated.
- F. The CONTRACTOR shall take every precaution to protect and avoid damage to sprinkler heads, irrigation lines, and other underground utilities during his grading and conditioning operations.

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- G. CONTRACTOR shall coordinate all drainage work with all other trades. Established site drainage shall be maintained by Contractor during all phases of landscape construction.
- H. Final finish grades shall insure positive drainage of the site with all surface drainage away from buildings, walls, and toward roadways, drains, and catch basins.
- I. Final grades shall be acceptable to the Landscape Architect before planting operations will be allowed to begin.
- J. The above conditions shall also apply to the final finish grade at the time of project completion.

3.6 PLANTING

A. General

- 1. The types, sizes and quantities of plant materials shall be as called for in the Specifications.
- 2. Planting shall be performed with materials, equipment, and procedures favorable to the optimum growth of the plants and in compliance with these procedures.
- 3. The CONTRACTOR shall be responsible for the condition of all plants, planted or otherwise, until acceptance.
- 4. Except as noted for specimen planting, all planting shall follow the completion of the irrigation system.

B. Protection and Storage

- 1. The CONTRACTOR shall keep all plant material delivered to the site in a healthy condition for planting.
- 2. Plants shall not be allowed to dry out.

C. Plant Container Removal:

- 1. Cut cans on two sides with acceptable can cutter. Do not cut cans with spade or ax.
- 2. Do not cut sides on knockout cans.
- 3. Carefully remove plants without injuring root ball.
- 4. Superficially cut or scarify sides of root ball if circular root growth is evident.

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D. Layout and Plant Location

1. The layout of locations for plants and outlines of groundcover and lawn areas to be planted shall be approved on the site by the Landscape Architect. All container plants shall be set by the CONTRACTOR in their final locations and approved by the Landscape Architect, prior to their planting. All such locations shall be checked for possible interference with existing underground piping, prior to excavation of holes.

If underground construction or utility lines are encountered in the excavation of planting areas, other locations for the planting may be selected by the Landscape Architect. Damage to existing utilities shall be the responsibility of the CONTRACTOR.

2. The first row of plants in areas designated for center-to-center spacing of plants shall be located at one-half of designated spacing from the edge of the area.

E. Planting Trees, Shrubs, and Vines:

1. All excavated holes shall have vertical sides with roughened surfaces and shall be of the minimum sizes indicated on Drawings. Holes shall be, in all cases, large enough to permit handling and planting without injury or breakage of root balls or roots.
2. Excavation shall include the stripping and stacking of all acceptable soil encountered within the areas to be excavated for plant pits and planting beds. Protect all areas that are to be trucked over and upon which soil is to be temporarily stacked pending its re-use for the filling of holes, pits, and beds.
3. Excess soil, generated from the planting holes shall be spread on the site as directed by the Landscape Architect.
4. Rocks and debris generated from the planting holes shall be removed from the site.
5. The plants shall be planted at approved locations with the heretofore- specified conditioner and soil planting backfill.
6. The plants shall be placed in the planting pits on the backfill or planter soil mix material which has been hand-tamped and water settled around each root ball to fill all voids.
7. Each tree and shrub shall be placed in the center of the hole as approved by the Landscape Architect and shall be set plumb and

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held rigidly in position until the planting backfill has been tamped down around each root ball.

8. All plants shall be set at such a level that after settling they bear the same relationship to the surrounding finish grade as they bore to the soil line grade in the container, unless otherwise noted. Plant crown shall not settle below surrounding grade.
9. Backfill shall be loosely placed around plant and then watered by hose so as to thoroughly saturate root ball and eliminate all air pockets in backfill. After watering additional backfill shall be placed and lightly compacted.
10. Water basins shall be created as required to adequately water trees and shrubs. All planting areas shall be left smooth and even.
11. Planting tablets shall be placed in each planting hole at the following rates:
 - 1 - 5 gram tablet per liner and flat size plant
 - 1 - 21 gram tablet per 1-gallon container
 - 2 - 21 gram tablets per 5-gallon container
 - 3 - 21 gram tablets per 15-gallon container
 - 1 - 21 gram tablet per each 6" of tree box size
12. No plant will be accepted if the root ball is broken or cracked, either before, during, or after the process of installation.
13. All plants shall be thoroughly watered into the full depth of each planting hole immediately after planting. Apply 1 oz. 'Sarvon' soil conditioner per gallon of water and fill basin with mixture at the rates indicated on the label based on plant size.
14. Remove all training stakes and ties from container stock.
15. All trees designated on the Drawings to be staked shall be staked with two wood stakes, one driven into the ground on the windward side of the tree root ball. The stakes shall be driven in plumb and secure avoiding penetration of the root ball. Special care shall be taken that the driving in of the stakes does not damage the tree roots or root ball. Tree ties shall be fastened to each tree and stake by looping figure 8's with the inside diameter of tie at 2 or 3 times the diameter of the tree and by taking the back of the tie to the stake (see Drawings). The staking shall be accomplished by the

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CONTRACTOR in such a manner as to insure the proper and healthy growth and the safety of the plants, property, and the public.

16. All trees larger than 24" box shall be guyed with a minimum of three guy wires, as detailed on Drawings. CONTRACTOR shall be responsible for the stability of the trees throughout the guarantee period.
17. All trees, 24" box and larger, shall be spotted and planted with a crane.
18. The CONTRACTOR shall be responsible for all surface and subsurface drainage required which may affect the guarantee of trees, shrubs, and vines.
19. Maintain all side growth on all plants. Prune plant material only as directed by Landscape Architect.
20. "Fan out" in a symmetrical radiating pattern all vines and espaliers after planting. Secure to adjacent fence or wall surface with non-metallic ties (3 at each vine minimum).
21. Pruning after planting shall be required on all trees, shrubs, and vines when necessary in the opinion of the Landscape Architect, to provide the specified or approved standard spates, form, and/or sizes characteristic to each plant. Pruning may include thinning, topping, and/or cutting and shall be under the direction of the Landscape Architect. Cuts over 3/4- inches in diameter shall be painted with an approved tree wound sealant.

F. Hydro-seeding:

1. Quality of work: The hydro-seeding work shall be performed by a competently trained individual or hydro-seeding company in accordance with the best standards and practices related to the trade.
2. Preparation for Hydro-seeding: Water all planting areas thoroughly and, continuously for three (3) consecutive days to saturate upper layers (top 5") of soil prior to hydro-seed operation.
3. Time Limit: the hydro-mulching slurry components are not to be left in the hydro-mulch machine for more than two (2) hours. If slurry components are left for more than two (2) hours in the machine, the CONTRACTOR shall add 75% more of the original seed mix to any slurry mixture that has not been applied eight (8) hours after mixing. Any mixture not applied after eight (8) hours shall be rejected and disposed of off-site at CONTRACTOR'S expense.

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4. Protection: Special care is to be exercised by the CONTRACTOR to prevent any of the slurry from being sprayed onto any adjacent property or planting area. Any slurry sprayed onto these areas shall be cleaned off at the CONTRACTOR'S expense.
5. Hydro-seeding Equipment: The specified components shall be mixed together in a hydro-seeding machine described as follows:
 - a) The hydro-mulching equipment shall meet the minimum requirements of a slurry distribution line large enough to prevent clogging and shall be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge of at least 25 PSI at the end of the spray nozzle.
 - b) The slurry tank shall have a minimum capacity of 2,000 gallons and shall be mounted on a traveling unit either self-propelled or drawn by a separate unit.
 - c) The equipment shall be a built-in agitation system under operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing not less than 20 kilos (44 pounds) of organic mulching amendment plus fertilizer, chemical additives, and solids for each 100 gallons of water.
6. Soil Stabilization and Hydro-seeding: All materials shall be standard, approved, first grade quality and in prime condition when installed. All commercial process or packaging material shall be delivered to the site in their original, unopened containers bearing the manufacturer's guarantee analysis.

G. Hydro-mulching Application and Planting Schedule

1. The hydro-mulching shall be applied in the form of a slurry consisting of organic soil amendments, commercial fertilizer, and other chemicals called for. When hydraulically sprayed onto the soil, the mulch shall be evenly distributed. The spray will penetrate the soil surface so as to drill and mix the slurry components into the soil, thus ensuring impregnation and coverage.
2. Preparation of Hydro-seeding Mixture: The slurry shall be prepared at the site and its components shall be mixed to supply the rates of application as per supplier's specifications and as indicated on Drawings.

Slurry preparation shall begin by adding water to the tank when the engine is at one-half throttle. When the water level has reached the

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height of the agitator shaft and good re-circulation has been established, the fertilizers shall be added to the mixture (the tank shall be at least 1/3 filled with water at this time).

The engine throttle shall be open to full speed when the tank is ½ filled with water. All organic amendments, fiber, and chemicals shall then be added by the time the tank is 2/3 to 3/4 full. At this time, the seed mix shall also be added.

Spraying shall commence immediately when the tank is full and the slurry is mixed.

3. Application: the operator shall spray the area with a uniform visible coat using the dark color of the cellulose fiber or organic amendment as a visual guide. The slurry shall be applied in a downward drilling motion via a fan stream nozzle.
4. Minimum coverage: Final acceptance will be given at the end of the maintenance period once 80% germination and plant establishment has been obtained.
5. Reapplication: All bare areas where hydro-seed is not establishing adequately after one (1) month shall be lightly raked and the hydro-seed mix re-applied in conformance with these specifications.
6. Weeding: Any concentrated development of weed growth appearing in the seed mix planting areas during the maintenance period shall be removed at 30 day intervals. The CONTRACTOR may elect to remove such concentrations of weeds manually or by an approved herbicide process.

H. Clean Up

1. As project progresses, CONTRACTOR shall maintain all areas in a neat manner and remove unsightly debris as necessary. After completion of project, CONTRACTOR shall remove all debris and containers used in accomplishing work. CONTRACTOR shall sweep and clean all sidewalks, asphalt, and concrete areas adjacent to plantings.
2. Upon completion of work and prior to pre-maintenance review, clean site to the satisfaction of the Landscape Architect and the RESIDENT ENGINEER.
3. Repair or replace existing or new site improvements or systems damaged during course of work.

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4. Remove completely from site improvements, stains resulting from contact with nitrogen stabilized redwood sawdust and drainage or contact with iron chelate. If such stains cannot be completely removed, replace improvement at CONTRACTOR'S expense.

3.7 FIELD QUALITY CONTROL

A. Pre-maintenance review:

1. A pre-maintenance review shall be performed at completion of all landscape planting and irrigation work and prior to beginning formal maintenance period, to determine substantial completion and acceptability to begin maintenance.
2. Request review by Landscape Architect no less than 24 hours prior to completion of work in order that mutually agreeable time may be arranged.
3. At time of pre-maintenance review, all planting areas shall be free of weeds and neatly cultivated.
4. If Landscape Architect finds all work has been performed and plant materials are in satisfactory growing condition, written notice of acceptance and commencement of maintenance period will be issued.
5. Work requiring corrective action in judgment of Landscape Architect shall be performed within ten days after pre-maintenance review.
6. Corrective work and materials replacement shall be in accordance with CONTRACT DOCUMENTS and shall be made at no expense to the OWNER.

B. Final Review:

1. At completion of maintenance period final review shall be performed.
2. Request review by Landscape Architect not less than 24 hours prior to completion of work in order that mutually agreeable time for review may be arranged.
3. At time of final review, planting areas shall be free of weeds and neatly cultivated.
4. Perform necessary corrective work and materials replacement identified during pre-maintenance review.

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5. If, after review, Landscape Architect finds work has been performed in accordance with CONTRACT DOCUMENTS and plant materials are in satisfactory growing condition, written notice of acceptance at end of maintenance period will be issued.
6. Work requiring corrective action in judgment of Landscape Architect shall be performed within ten days after final review.
7. Corrective work and materials replacement shall be in accordance with Contract Documents and shall be made at no expense to the OWNER.
8. Maintenance period shall be continued at no expense to the OWNER as determined by Landscape Architect until final acceptance of completed work is accomplished.
9. Upon completion of corrective work and materials replacement, request review.

3.8 MAINTENANCE

- A. Regular planting maintenance operations shall begin immediately after all trees and/or lawn is planted and is accepted with written approval by the Landscape Architect. All plant material shall be kept in a healthy, optimum growing condition and in a visually pleasing appearance by watering, pruning, mowing, fertilizing, re-staking, pest and disease controlling, spraying, weeding, cleanup and any other necessary operation of maintenance. Landscape areas shall be kept free of weeds, noxious grass, and all other undesired vegetative growth and debris.
- B. The CONTRACTOR shall continuously maintain all involved areas of the Contract during the progress of the work and during the Maintenance Period until the Final Acceptance of the work by the Landscape Architect.
- C. The Maintenance Period shall be extended, when in the opinion of the Landscape Architect, improper maintenance and/or possible poor or unhealthy condition of planted materials are evident at the termination of the scheduled Maintenance Period. The CONTRACTOR shall be responsible for additional maintenance of the work at no change in contract price until all of the work is completed and acceptable to the Landscape Architect.
- D. All damage to existing property (buildings, utilities, etc.) or planting (trees, shrubs, lawn, or groundcover) caused by the CONTRACTOR during his operation or as a result of malfunction or installed work during the guarantee period shall be repaired at CONTRACTOR'S expense.

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- E. In order to carry out the plant establishment work, the CONTRACTOR shall furnish sufficient men and adequate equipment to perform the work during the plant establishment period.
- F. Remove trash, debris and other deleterious material weekly from all planting areas.
- G. All paved areas shall be cleaned of debris caused by maintenance operations or silting.
- H. Erosion rivulets shall be filled and stabilized immediately upon formation.
- I. All bark-mulched areas and planted areas shall be treated with an approved granular pre-emergent herbicide according to manufacturer's specifications at the beginning of the maintenance period and, if the product specifies, additional scheduled treatments on a regular schedule, as required through the maintenance period.
- J. Maintenance of Plant Materials:
 - 1. Maintenance of trees, shrubs, groundcovers and/or lawn shall include proper watering, fertilizing, pest and disease control, and other functions necessary to insure a healthy, vigorous stand of plants at the time of final inspection.
 - 2. On the 30th, 60th, and 90th days of the Maintenance Period, the Contractor shall apply 12-4-6 post planting fertilizer at the rate of 6 lbs. per 1,000 sq. ft. to the planted areas.
- K. In all planting areas, mechanically remove any tumbleweed, thistle, pampas grass, or wild mustard infestations, or other noxious weeds. Herbicides will not be allowed.
- L. All dead, damaged or broken plant material, including hydro-seed and groundcover, shall be replaced at two-week intervals.
- M. Plant material may be rejected at any time by the Landscape Architect due to condition, form, or damage before or after planting through the maintenance period.
- N. Landscape Contractor shall repair and/or replace any plant material existing on site, which is damaged due to his negligence, at CONTRACTOR'S expense.
- O. CONTRACTOR shall call for a final inspection two (2) weeks before the end of the 90-day maintenance period. Failure to pass inspection will result in an extension of the maintenance period for such period, as the Landscape Architect deems necessary.
- P. Tree, Shrub and Groundcover Care:

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1. Removal and replacement: At two week intervals, remove dead, dying, damaged or diseased plant material, including hydro-seed and groundcover, and replace with plants of equal size, condition, and variety of original planting plan.
2. Watering:
 - a) Apply adequate amount of irrigation water throughout maintenance period to keep palms and shrubs in healthy and vigorous growing condition.
 - b) Maintain large enough water basin around plants so that enough water can be applied to establish moisture through major root zone. When hand watering, use water wand to break water force. Replace lost fir bark mulch, as necessary, to reduce evaporation and frequency of watering.
3. Plant material may be rejected at any time by the Landscape Architect due to condition, form, or damage before or after planting through the maintenance period.
4. Tree and Shrub Pruning:
 - a) Prune shrubs to select and develop permanent scaffold branches that are smaller in diameter than trunk or branch to which attached, which have vertical spacing of from 4 to 12 in., and radial orientation so as not to overlay one another; to eliminate diseased or damaged growth; to eliminate narrow V-shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain growth within space limitations; to maintain natural appearance; to balance crown with roots; and prevent interference with adjacent site improvements.
 - b) Shrubs shall not be clipped into balled or boxed forms unless form is required by design.
 - c) Pruning cuts shall be made to lateral branches or buds, or flush with trunk. "Stubbing" will not be permitted.
5. Weed, Insect and Disease Control:
 - a) The CONTRACTOR shall control weeds, disease, and pest infestations in the planting areas. The Landscape Architect shall approve all methods and materials for such control upon approval. The CONTRACTOR shall implement the control measures exercising extreme caution in using

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pesticides and taking all steps to ensure the safety of the public. Only licensed personnel will be permitted to perform toxic spraying.

- b) Replace lost bark mulch, as necessary, to help prevent weed seed germination.
- c) In all planting areas, mechanically remove any tumbleweed, thistle, or wild mustard infestations. Herbicides will not be allowed.

6. Fertilization:

- a) On the 30th, 60th, and 90th days of the Maintenance Period, the Contractor shall apply 12-4-6 post planting fertilizer at the rate of 6 lbs. per 1,000 sq. ft. to the planted areas.
 - 1) Post-planting fertilizer shall conform to specifications.

2) Application rates:

	<u>Rate</u>	<u>Fertilizer Type</u>
a) Trees	½ lbs. per each trunk caliper	Post planting 12-4-6
b) Shrubs, Vines & Groundcover	6 lbs. per 1,000 sq. ft. Planting area	Post Planting 12-4-6

- 3) Apply fertilizer with acceptable equipment.
- 4) Apply fertilizer when plants and planting areas are in dry condition, apply irrigation immediately after fertilizer application.

**** END OF SECTION ****

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 01300 Submittals
 - 2. Section 03200 Reinforcement Steel
 - 3. Section 03290 Joints in Concrete Structures
 - 4. Section 03300 Cast-in-Place Concrete
 - 5. Section 03315 Grout
 - 6. Section 06100 Rough Carpentry

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the 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. PS 1 U.S. Product Standard for Concrete Forms, Class I

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2. PS 20 American Softwood Lumber Standard
3. ACI 117 Standard Tolerances for Concrete Construction and Materials
4. ACI 347 Recommended Practice for Concrete Formwork

1.4 SUBMITTALS

- A. The CONTRACTOR shall, in accordance with the requirements in Section 01300 - Submittals, submit detailed drawings of the false work proposed to be used. Such drawings shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the false work, means of protecting existing construction which supports false work, and typical soil conditions. Shoring and falsework design drawings and calculations shall be stamped and signed by a professional engineer registered in the State of California.
- B. The CONTRACTOR shall, in accordance with the requirements in Section 01300 - Submittals, submit the following.
 1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
 2. Form gaskets.
- C. The CONTRACTOR shall provide concrete construction joints and expansion joints of the types and locations indicated on the Drawings. The CONTRACTOR shall submit shop drawings showing the proposed location and type of required construction for any joints not shown on the Drawings, and the sequence of forming and concrete placing operations.
- D. Forms and false work to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads shall be 100 psf.

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR shall comply with the requirements of California Division of Occupational Health and Safety Construction Safety Orders Section 1717 and OSHA Part 1926, Section 1926.701 that apply to the Work of this Section. The CONTRACTOR shall prepare and maintain at least one copy of the required drawings at the site. Design of the structures shown on the Drawings does not include any allowance or consideration for imposed construction loads. 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,

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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 RESIDENT ENGINEER, 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.

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2.3 FORM TIES

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

2.4 FORM COATING

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

2.5 FORM JOINT SEALERS

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

PART 3 -- EXECUTION

3.1 GENERAL

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

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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 RESIDENT ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.

- 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 RESIDENT ENGINEER. 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 RESIDENT ENGINEER.

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

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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 RESIDENT ENGINEER. 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:

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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 RESIDENT ENGINEER 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 RESIDENT ENGINEER 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 RESIDENT ENGINEER.

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3.6 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the RESIDENT ENGINEER. 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 RESIDENT ENGINEER.

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 RESIDENT ENGINEER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.8 FALSE WORK

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

3.9 REMOVAL OF SHORING AND FALSE WORK

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

3.10 LOAD RESTRICTION

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

**** END OF SECTION ****

SECTION 03200 – REINFORCEMENT STEEL

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 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 01300 Submittals
 - 2. Section 03100 Concrete Formwork
 - 3. Section 03290 Joints in Concrete Structures
 - 4. Section 03300 Cast-in-Place Concrete
 - 5. Section 03315 Grout
 - 6. Section 04232 Reinforced Concrete Block Masonry

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- C. Commercial Standards (Current Edition):

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1. ACI 315 Details and Detailing of Concrete Reinforcement
 2. ACI 318 Building Code Requirements for Structural Concrete
 3. CRSI MSP Concrete Reinforcing Steel Institute Manual of Standard Practice
 4. WRI Manual of Standard Practice for Welded Wire Fabric
 5. AWS D1.4 Structural Welding Code - Reinforcing Steel
- D. ASTM Standards in Building Codes (Current Edition):
1. ASTM A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement
 2. ASTM A 185 Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement
 3. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 4. ASTM A 706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
 5. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars

1.4 SUBMITTALS

- A. The CONTRACTOR shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel before fabrication in accordance with the requirements of Section 01300 - Submittals.
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

1.5 QUALITY ASSURANCE

- A. If requested by the RESIDENT ENGINEER, 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

SECTION 03200 – REINFORCEMENT STEEL

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 A 615 for Grade 60 Billet Steel Reinforcement or as otherwise indicated.
2. All welded reinforcement, specifically detailed or otherwise indicated, shall be low-alloy grade 60 deformed bars conforming to the requirements of ASTM A 706.
3. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either provided in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be provided in flat sheets only.
4. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.
5. Tie wire shall be Annealed Steel, 14 gauge minimum.

- B. Accessories:

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice, Chapter 3, including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a c-inch minimum thickness of plastic coating which extends at least 2-inch from the concrete surface. Plastic shall be gray in color.

SECTION 03200 – REINFORCEMENT STEEL

2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
 - C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775.
- 2.3 MECHANICAL COUPLERS
- A. Mechanical couplers shall 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 specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements found in Section 03315 - Grout.

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

SECTION 03200 – REINFORCEMENT STEEL

- 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 RESIDENT ENGINEER.
- 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

SECTION 03200 – REINFORCEMENT STEEL

reinforcement mat, and shall support the reinforcement mat in the plane indicated.

- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
- I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.
- J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPLICES

- A. Splicing shall be in accordance with ACI-318, unless otherwise noted on Drawings.
- B. Vertical Bars. Except as specifically detailed or otherwise indicated, splicing of vertical bars in concrete is not permitted, except at the indicated or approved horizontal construction joints or as otherwise specifically detailed.
- C. Horizontal Bars. Except as specifically detailed or otherwise indicated, splicing of horizontal bars in concrete is not permitted.

3.5 ADDITIONAL REINFORCING

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

3.6 WELDED WIRE MESH

- A. The CONTRACTOR shall install necessary supports and chairs to hold the wire mesh in place during concrete pours. The CONTRACTOR shall straighten mesh to lay in a flat plane and bend mesh as shown or required to fit work. The CONTRACTOR shall provide laps of no less than one complete mesh, unless otherwise detailed, and shall tie every other wire at laps. Roll mesh is not acceptable.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

- A. Hole Preparation:

SECTION 03200 – REINFORCEMENT STEEL

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

**** END OF SECTION ****

SECTION 03280 – JOINTS IN SITE 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 01300 Submittals
 - 2. Section 03100 Concrete Formwork
 - 3. Section 03310 Cast-in-Place Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the DESIGN/BUILDER shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the California Building Code (CBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code.
- C. ASTM Standards in Building Codes (Current Edition):
 - 1. ASTM D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and resilient Bituminous Types)
 - 2. ASTM D 994 Preformed Expansion Joint Filler for Concrete (Bituminous Type)

1.4 DESIGN/BUILDER SUBMITTALS

- A. The DESIGN/BUILDER shall submit the following in compliance with Section 01300 - Submittals.
 - 1. Placement shop drawings showing the location and type of all joints.

SECTION 03280 – JOINTS IN SITE CONCRETE

2. Catalog cuts and samples of the preformed expansion joint filler material, including complete product data.

1.5 OPERATION AND MAINTENANCE INFORMATION

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

PART 2 -- PRODUCTS

2.1 PREMOLDED JOINT FILLER

- A. Premolded joint filler shall be in conformance with SSPWC Subsection 201-3.2 and shall be either Preformed Expansion Joint Filler (ASTM D994) or Nonextruding and Resilient Filler (ASTM D 1751) as indicated.

2.2 STEEL BARS AND DOWELS

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

2.3 CONCRETE CURING COMPOUND

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

PART 3 -- EXECUTION

3.1 EXPANSION JOINTS

- A. Expansion joints in concrete pavement shall be constructed in accordance with SSPWC Subsection 302-6.5 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

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- 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 the latest edition of SSPWC for the compound used.

**** END OF SECTION ****

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, 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 01300 Submittals
2. Section 03100 Concrete Formwork
3. Section 03200 Reinforcement Steel
4. Section 03300 Cast-in-Place Concrete
5. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The current edition of the 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 for expansion joints.
- D. U.S. Army Corps of Engineers Specifications:
1. CRD-C572 PVC Waterstop
- E. ASTM Standards in Building Codes (Current Edition):
1. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars

SECTION 03290 – JOINTS IN CONCRETE STRUCTURES

2. ASTM C 920 Specification for Elastomeric Joint Sealants
3. ASTM D 412 Test Methods for Rubber Properties in Tension
4. ASTM D 624 Test Method for Rubber Property -- Tear Resistance
5. ASTM D 638 Test Method for Tensile Properties of Plastics
6. ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
7. ASTM D 747 Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
8. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bar
9. ASTM D 1056 Specification for Flexible Cellular Materials -- Sponge or Expanded Rubber
10. ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
11. ASTM D 2000 Standard Classification System for Rubber Product in Automotive Applications
12. ASTM D 2240 Test Method for Rubber Property -- Durometer Hardness
13. ASTM D 2241 Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series)

1.4 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.
- B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 2-4 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

SECTION 03290 – JOINTS IN CONCRETE STRUCTURES

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 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 RESIDENT ENGINEER 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

SECTION 03290 – JOINTS IN CONCRETE STRUCTURES

- 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 RESIDENT ENGINEER to provide for the required inspections. Not less than 24 hours notice shall be given to the RESIDENT ENGINEER 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.
- D. Waterstop Samples: Before use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the RESIDENT ENGINEER for review. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be provided under this contract. Field samples of fabricated fittings will be selected at random by the RESIDENT ENGINEER for testing by a laboratory at the OWNER's expense. When tested, PVC waterstops shall have a tensile strength across the joints equal to at least 600 psi.

SECTION 03290 – JOINTS IN CONCRETE STRUCTURES

- E. Construction Joint Sealant: The CONTRACTOR shall prepare adhesion and cohesion test specimens as indicated, at intervals of 5 working days while sealants are being installed.
- F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
 - 1. Sealant specimens shall be prepared between two concrete blocks (1 inch by 2 inches by 3 inches). Spacing between the blocks shall be 1 inch. Coated spacers (2 inches by 12 inches by 2 inch) shall be used to insure sealant cross-sections of 2 inch by 2 inches with a width of 1-inch.
 - 2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
 - 3. Following curing period, the gap between blocks shall be widened to 1-2 inch. Spacers shall be used to maintain this gap for 24 hours before inspection for failure.

1.7 WARRANTY

- A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, along with a statement that it agrees to repair or replace, to the satisfaction of the RESIDENT ENGINEER 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 RESIDENT ENGINEER 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 d inch. Flatstrip

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and center-bulb waterstops shall be manufactured by Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal.

- C. **Multi-Rib Waterstops:** Multi-rib waterstops, where required, shall be manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.
- D. **Other Types of Waterstops:** When other types of waterstops not listed above are required and indicated, they shall be subjected to the same requirements as those listed herein.
- E. **Waterstop Testing Requirements:** When tested in accordance with the standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1,750	D 638, Type IV
Ultimate Elongation-min (%)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1,500	D 638, Type IV
Ultimate Elongation-min (%)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (%)+0.25/-0.10		
Change in Durometer, Shore A	+5	D 2240
Finish Waterstop		
Tensile Strength-min (psi)	1,400	D 638, Type IV
Ultimate Elongation-min (%)	280	D 638, Type IV

2.3 JOINT SEALANT

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.
- B. Joint sealant material shall meet the following requirements (73 degrees F and 50% relative humidity):

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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) minimum	75 pounds per inch of thickness, minimum
Color	Light Gray

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- C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:
1. Sealant shall be two-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for two-part material, as applicable.
 2. For vertical joints and overhead horizontal joints, only "nonsag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
 3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing nontracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
 4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
- D. All sealants, wherever shown, or required hereunder shall be PSI-270 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation, or equal.
- E. Sealants for nonwaterstop joints in concrete shall conform to the requirements of Section 07920 - Sealants and Calking.

2.4 JOINT MATERIALS

- A. Bearing Pad: Bearing pad to be neoprene conforming to ASTM D 2000 BC 420, 40 durometer hardness unless otherwise indicated.
- B. Neoprene Sponge: Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D 1056, Type 2C3-E1.
- C. Joint Filler:
1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.
 2. Joint filler material in other locations shall be of the preformed nonextruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type

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preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.

2.5 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25% at 8 psi. The rod shall be 1/4 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 Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Select Cure CRB as manufactured by Select Products Co., Upland, California, or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.7

2.7 SLIP DOWELS

- A. Slip dowels in joints shall be A36 smooth epoxy-coated bars, as indicated on the Drawings, and conforming to ASTM A 775.

2.8 PVC TUBING

- A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D 2241.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Waterstops of the type indicated shall be embedded in the concrete across joints as indicated. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect

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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

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12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

- C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.
- D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- E. Joint Location: Construction joints, and other types of joints, shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints, of any type, shall be submitted for acceptance by the RESIDENT ENGINEER.
- 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

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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.

**** END OF SECTION ****

SECTION 03300 – CAST-IN-PLACE 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 01300 Submittals
 - 2. Section 0200 Earthwork
 - 3. Section 03100 Concrete Formwork
 - 4. Section 03200 Reinforcement Steel
 - 5. Section 03280 Joints in Site Work Concrete
 - 6. Section 03290 Joints in Concrete Structures
 - 7. Section 03315 Grout
 - 8. Section 06100 Rough Carpentry
 - 9. Section 07133 Waterproofing

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

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Construction (SSPWC), together with the latest adopted editions of the Regional and 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)
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2. Commercial Standards:

ACI 117	Standard Tolerances for Concrete Construction and Materials
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ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
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ACI 301	Specifications for Structural Concrete for Buildings
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ACI 304R	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
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ACI 305R	Hot Weather Concreting
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ACI 306	Cold Weather Concreting
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ACI 309	Consolidation of Concrete
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ACI 315	Details and Detailing of Concrete Reinforcement
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ACI 318	Building Code Requirements for Reinforced Concrete
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ACI 350R	Environmental Engineering Concrete Structures
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3. ASTM Standards in Building Codes:

ASTM C 31	Practice for Making and Curing Concrete Test Specimens in the Field
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ASTM C 33	Specification for Concrete Aggregates
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ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C 42	Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 94	Specification for Ready-Mixed Concrete
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138	Test Method for Unit Weight, Yield, and Air Content of Concrete
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 156	Test Method for Water Retention by Concrete Curing Materials
ASTM C 157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C 192	Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 289	Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C 309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete

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ASTM C 1077	Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM E 119	Method for Fire Tests of Building Construction and Materials
NSF/ANSI 61	Drinking Water System Components - Health Effects, NSF International

1.4 SUBMITTALS

- A. Mix Designs: Before starting the Work and within 14 days of the notice to proceed, the CONTRACTOR shall submit to the RESIDENT ENGINEER, 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 RESIDENT ENGINEER 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. Cement and concrete admixtures shall be NSF 61 certified. NSF 61 certificates of compliance shall be provided as submittals
- D. The CONTRACTOR shall provide the following submittals in accordance with ACI 301:
 - 1. Mill tests for cement.

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2. Admixture certification. Chloride ion content must be included.
 3. Aggregate gradation and certification.
 4. Materials and methods for curing.
- E. The CONTRACTOR shall provide catalog cuts and other manufacturer's technical data demonstrating compliance with the requirements indicated and specified herein for all admixtures used in the concrete mix design.

1.5 CONCRETE CONFERENCE

- A. A meeting shall be held to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction no later than 14 days after the Notice to Proceed.
- B. All parties involved in the concrete work shall attend the conference, including the following:
1. CONTRACTOR's representative
 2. Testing laboratory representative
 3. Concrete subCONTRACTOR
 4. Reinforcing steel subCONTRACTOR and detailer
 5. Concrete supplier
 6. Admixture manufacturer's representative
- C. The conference shall be held at a mutually agreed upon time and place. The RESIDENT ENGINEER shall be notified no less than 5 days before the date of the conference.

1.6 QUALITY ASSURANCE

- A. General:
1. Tests on component materials and for compressive strength of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
 2. The cost of all laboratory tests requested by the RESIDENT ENGINEER 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

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meet the Specifications. The laboratory must meet or exceed the requirements of ASTM C 1077.

3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall provide assistance to the RESIDENT ENGINEER 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 RESIDENT ENGINEER to ensure continued compliance with these Specifications. Each set of test specimens will be a minimum of five cylinders.
2. Compression test specimens for concrete shall be made in accordance with section 9.2 of ASTM C 31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
3. Compression tests shall be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and two at 28 days. The remaining cylinders will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality," and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below 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.

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5. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no increase in cost to the OWNER.

D. Shrinkage Tests:

1. Drying shrinkage tests will be made for the trial batch specified in the Paragraph in Part 2 entitled, "Trial Batch and Laboratory Tests," the first placement of each class of concrete, and during construction to insure continued compliance with these Specifications.
2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: specimens shall be removed from molds at an age of 23 ± 1 hours after trial batching, shall be placed immediately in water at $70 \text{ degrees F} \pm 3 \text{ degrees F}$ for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at $73 \text{ degrees F} \pm 3 \text{ degrees F}$. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at $73 \text{ degrees F} \pm 3 \text{ degrees F}$ and 50 percent ± 4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
3. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of the test age by more than 0.0004-inch, the results obtained from the specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the projects. Allowable shrinkage limitations shall be as specified in spec section 2.08, herein 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

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dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

- E. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

<u>Item</u>	<u>Tolerance</u>
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation from plumb.	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 1/4-inch

- F. Floor Slab Surface Hardener:

1. Job Mockup: In a location designated by the RESIDENT ENGINEER, place a minimum 100 square feet floor mockup using materials and procedures proposed for use in the Project. Revise materials and procedures as necessary to obtain acceptable finish surface. Maintain the same controls and procedures used in the acceptable mockup throughout the Project.
2. Field Service: During job mock-up and initial period of installation, the manufacturer of the surface hardener shall furnish the service of a trained, full-time representative to advise on proper use of the product. Notify surface hardener manufacturer at least three days before initial use of the product.

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3. Installer Qualifications: Installer shall have a minimum of 3 years experience and shall be specialized in the application of dry shake surface hardeners.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General:

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

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

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

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

1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type 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 RESIDENT ENGINEER. 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 RESIDENT ENGINEER if requested regarding compliance with these Specifications.
2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids concentration (over 1,000 mg/l) shall not be used.

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3. Aggregates shall be obtained from pits acceptable to the RESIDENT ENGINEER, shall be nonreactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified herein. Lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4 inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the Paragraph in Part 2 entitled "Trial Batch and Laboratory Tests" for the use of the size groups.
 - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D 2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
 - c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - d. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
 - e. When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - f. When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.

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- g. When tested in accordance with ASTM C 33, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.
- 4. Ready-mix concrete shall conform to the requirements of ASTM C 94.
- 5. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be nontoxic after 30 days.
 - a. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. The RESIDENT ENGINEER reserves the right, at any time, to sample and test the air-entraining agent received on the job. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air entraining agent shall be Darex II by W.R. Grace; AEA-92 by Euclid Chemical Company; or equal.
 - b. Set controlling and water reducing admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, effect water reduction, and increase workability. The addition of an admixture shall be at no increase in cost to the OWNER. The use of an admixture shall be subject to acceptance by the RESIDENT ENGINEER. Concrete containing an admixture shall be first placed at a location determined by the RESIDENT ENGINEER. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
 - (1) Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the RESIDENT ENGINEER.
 - (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

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be consistently over 80 degrees F, a set retarding admixture such as Eucon Retarder by Euclid Chemical Company; Daratard 17 by W.R. Grace; or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a noncorrosive set accelerating admixture such as Plastocrete 161FL by Sika Corporation; Pozzutec 20 by Master Builders; Daraset by W.R. Grace; or equal shall be used.

- (3) Normal range water reducer shall conform to ASTM C 494, Type A. WRDA 64 by W.R. Grace; Eucon WR-91 by Euclid Chemical Company; or equal. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.
- (4) High range water reducer shall conform to ASTM C 494, Type F or G. ADVA 190 by W.R. Grace; Eucon 1037 by Euclid Chemical Company; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.
- (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

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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 C 309:

1. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Kurez by Euclid Chemical Company; L&M Cure R; MB-429 as manufactured by Master Builders; or equal. Water based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent based compound. Water based curing compounds shall be L&M Cure R-2; Aqua-Cure by Euclid Chemical Company; Masterkure-W by Master Builders; or equal.
2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
5. Curing mats for use in Curing Method 6 as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
6. Evaporation retardant shall be a material such as Confilm as manufactured by Master Builders; Eucobar as manufactured by Euclid Chemical Company; or equal.

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2.3 NONWATERSTOP JOINT MATERIALS

- A. Materials for nonwaterstop joints in concrete shall conform to the following requirements:
 - 1. Preformed joint filler shall be a nonextruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
 - 2. Elastomeric joint sealer shall conform to ASTM C 920, Type S, Grade NSA, Class 25, and shall be polyurethane-based. The sealant shall be formulated for exterior use and exposure to ultra-violet rays.
 - 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 RESIDENT ENGINEER.

2.4 MISCELLANEOUS MATERIALS

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

2.5 CONCRETE DESIGN REQUIREMENTS

- A. Mix Design.

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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 RESIDENT ENGINEER.

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.

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Type of Work	Min 28-Day Compressive Strength (psi)	Max Size Aggregate (in)	Minimum Cement per cu yd (lb)	Max W/C Ratio (by weight)
Structural Concrete:				
Roof, floor slabs, columns, walls and all other concrete items not specified elsewhere	4,000	3/4	564	0.45
12" and thicker walls, slabs on grade and footings, with written approval of the RESIDENT ENGINEER	4,000	1	564	0.45
Pea Gravel Mix Thin sections and areas with congested reinforcing, at the CONTRACTOR'S opinion and with the written approval of the RESIDENT ENGINEER for the specific location	4000	3/8	752	0.40
Other Concretes:				
Sitework concrete	3,000	1	470	0.50

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Lean Concrete	2,500	1-1/2	376	0.50
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Note: The CONTRACTOR is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.

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

B. Consistency

- 1. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (in)
All concrete, unless note otherwise	3 inches ± 1 inch
With high range water reducer added	6 inches ± 2 inches
Pea gravel mix	7 inches ± 2 inches
Ductbanks	5 inches ± 1 inch

C. Trial Batch and Laboratory Tests

- 1. Before placing any concrete, a testing laboratory designated by the RESIDENT ENGINEER 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

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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 C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
3. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.
4. In lieu of trial batch and laboratory tests specified in this Section, the CONTRACTOR may submit previously-designed, tested, and successfully-used concrete mixes, using materials similar to those intended for this project, together with a minimum of three certified test reports of the 28-day strength of the proposed concrete mix.

D. 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 RESIDENT ENGINEER.
2. Weighing Tolerances:

Material	Percent of Total Weight
Cement	1

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Aggregates	3
Admixtures	3

E. 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 RESIDENT ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

2.6 READY MIXED CONCRETE

- A. At the CONTRACTOR's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.
- B. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches,

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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 RESIDENT ENGINEER 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 RESIDENT ENGINEER.

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 ALumiplate®, by Master Builders, Inc., or equal.
- B. Curing Compound shall meet the moisture retention requirements of ASTM C 309 and surface hardener manufacturer's recommendations.
- C. Monomolecular Film: Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by surface hardener manufacturer.

2.8 SHRINKAGE LIMITATION

- A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete used as part of a hydraulic structure.

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- B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 20 percent.
- C. If the required shrinkage limitation is not met during construction, the Contractor shall take any or all of the following actions, at no additional cost to the OWNER, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

PART 3 -- EXECUTION

3.1 PROPORTIONING AND MIXING

- A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.
- C. Slump: Maximum slumps shall be as specified herein.
- D. 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 RESIDENT ENGINEER, 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.

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- C. 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 RESIDENT ENGINEER.
- E. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the RESIDENT ENGINEER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- F. All inserts or other embedded items shall conform to the requirements herein.
- G. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the RESIDENT ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- H. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the RESIDENT ENGINEER.
- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the RESIDENT ENGINEER.
- J. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported before placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- K. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.

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- L. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- M. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Nonconforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no additional expense to the OWNER.
- C. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the RESIDENT ENGINEER. The CONTRACTOR shall notify the RESIDENT ENGINEER 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

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to the RESIDENT ENGINEER. 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. Cold Weather Placement
 - 1. Placement of concrete shall conform to ACI 306.1 – Standard Specification for Cold Weather Concreting, and the following

Remove all snow, ice and frost from the surface, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above 32 degrees F before concrete placement.

Maintain the concrete temperature above 50 degrees F for at least 3 days after placement.
- I. Hot Weather Placement:
 - 1. Placement of concrete shall conform to ACI 305R - Hot Weather Concreting, and the following.

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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. Pumping Equipment: The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the Work shall be acceptable to the RESIDENT ENGINEER. 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

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removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309) high speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the RESIDENT ENGINEER.
- 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

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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 RESIDENT ENGINEER.
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:

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UNFORMED SURFACE FINISH SCHEDULE

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs which are water bearing with slopes 10 percent and less	U3
Sloping slabs which are water bearing with slopes greater than 10 percent	U4
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Top surface of walls	U3

E. Floor Hardener (Surface Applied)

1. Where hardener for floors is indicated, provide concrete with the following additional requirements:
 - a. Maximum slump of 4 inches when peak ambient temperatures are expected to be more than 65 degrees F, and no more than 3 inches when ambient temperatures are below 65 degrees F.
 - b. Maximum air content of 3 percent.
 - c. Do not use calcium chloride or set-accelerating admixtures containing calcium chloride.
 - d. Do not use admixtures that increase bleeding.
2. After the concrete has been leveled and as soon as the concrete will support an operator and machine without disturbing the level or working up excessive fines, float the surface of the slab with a mechanical float fitted with float shoes. Following floating, apply 1/2 to 2/3 of the total amount of dry shake surface hardener so that a uniform distribution of surface hardener is obtained. The use of a

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mechanical spreader is recommended. Once the shake has absorbed sufficient moisture (indicated by the darkening of the shake), float the surface. Immediately apply the remaining 1/3 to 1/2 of the shake and allow to absorb moisture. Do not place dry shake on concrete surface when bleed water is present.

3. Use finishing machines with detachable float shoes. Compact surface by a third mechanical floating if time and setting characteristics of the concrete will allow. Do not add water to the surface.
4. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel with blades set relatively flat. Remove all marks and pinholes in the final raised trowel operation.
5. Follow all application instructions of the floor surface hardener manufacturer.
6. Cure finished floors using fill-forming curing compound recommended by surface hardener manufacturer. Uniformly apply curing compound over the entire surface at a coverage that will provide moisture retention in excess of the requirements of ASTM C 309. Maintain ambient temperature of 50 degrees F or above during the curing period.
7. Keep floors covered and free of traffic and loads for a minimum of 14 days after completion.

3.8 ARCHITECTURAL FINISH

- A. General: Architectural finishes shall be required only where specifically called out on the Drawings. In all other cases, the paragraph above, entitled Finishing Concrete Surfaces, shall apply.
 1. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and all form-tie holes filled as indicated herein.
 2. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
 3. All architecturally treated concrete surfaces shall conform to the accepted sample required herein in texture, color, and quality. It shall be the CONTRACTOR's responsibility to maintain and protect the concrete finish.

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B. Smooth Concrete Finish:

1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one part portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 1/2 gray and 1/2 white portland cement, as determined by the RESIDENT ENGINEER. 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 RESIDENT ENGINEER and shall preserve said trial area undisturbed until the completion of the job.

B. Sandblasted Concrete Finish

1. Sandblasting shall be done in a safe manner acceptable to local authorities and per OSHA requirements. The sandblasting shall be a light sandblast to remove laitance and to produce a uniform fine aggregate surface texture with approximately 1/32 to 1/16 inch of surface sandblasted off. Corners, patches, form panel joints, and soft spots shall be sandblasted with care.
2. A 3-square foot sample panel of the sandblasted finish shall be provided by the CONTRACTOR for acceptance by the RESIDENT ENGINEER before starting the sandblasting Work. The sample panel shall include a corner, plugs, and joints and shall be marked after

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approval. All other sandblasting shall be equal in finish to the sample panel.

- 3. Protection against sandblasting shall be provided on all surfaces and materials not requiring sandblasting but within or adjacent to areas being sandblasted. After sandblasting, the concrete surfaces shall be washed with clean water and excess sand removed.

3.9 CURING AND DAMPPROOFING

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

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4
Floor slabs on grade	5
Slabs not on grade	6

- B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 6, herein.
- C. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations

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that may damage the concrete shall not begin until at least 7 days after placement of concrete.

- E. Method 4: The surface shall be sprayed with a liquid curing compound.
1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just before the placing of new concrete.
 4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.
 5. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the previously coated panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
 6. Before final acceptance of the Work, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage surface finish.
- F. Method 5:
1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.

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The concrete shall be given a coat of curing compound in accordance with Method 4, herein. Not less than 1 hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3 inches and fastened together with a waterproof cement to form a continuous watertight joint.

2. The curing blankets shall be left in place during the 14-day curing period and shall not be removed until after concrete for adjacent Work has been placed. Should the curing blankets become torn or otherwise ineffective, replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. Add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6: This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days beginning immediately after the concrete has reached final set or forms have been removed.
2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes and to be substantially in contact with the concrete surface. All edges shall be continuously held in place.
4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry

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spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4, herein.

6. Dispose of excess water from the curing operation to avoid damage to the Work.
- H. Dampproofing: The exterior surface of all buried roof slabs shall be dampproofed as follows:
1. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in two coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as specified herein.
 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.

3.9 PROTECTION

- A. Protect all concrete against injury until final acceptance by the RESIDENT ENGINEER.
- 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.

3.10 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

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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.

3.11 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 RESIDENT ENGINEER. 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

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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.

3.12 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,

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unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.

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

3.13 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 RESIDENT ENGINEER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time before the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the CONTRACT DOCUMENTS, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR's expense.

**** END OF SECTION ****

SECTION 03310 – CAST-IN-PLACE SITEWORK CONCRETE

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 01300 Submittals
 - 2. Section 03280 Joints in Sitework Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1.4 CONTRACTOR SUBMITTALS

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

1.5 TESTS

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

SECTION 03310 – CAST-IN-PLACE SITEWORK CONCRETE

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

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

2.2 FORMWORK

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

2.3 STEEL REINFORCEMENT

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

PART 3 -- EXECUTION

3.1 GENERAL

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

3.2 AIR-PLACED CONCRETE

- A. Air-placed concrete construction (gunite and shotcrete) shall be in accordance with SSPWC Subsection 303-2 and the applicable provisions of Subsection 303-1.

**** END OF SECTION ****

SECTION 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 01300 Submittals
 - 2. Section 03300 Cast-in-Place Concrete
 - 3. Section 03310 Cast-in-Place Site Work Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following standards apply to the work of this Section:
 - 1. Commercial Standards:
 - CRD-C 621 Corps of Engineers Specification for Non-shrink Grout
 - 2. ASTM Standard in Building Codes:
 - ASTM C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)

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ASTM C 531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C 579	Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C 827	Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixture
ASTM C 881	Specification for Epoxy-Resin-Base Bonding System for Concrete
ASTM C 882	Standard Test for Bond Strength of Epoxy-Resin Systems Used with Concrete.
ASTM C 884	Standard Test Method for Thermal Compatibility between Concrete and an Epoxy-Resin Overlay.
ASTM D 638	Standard Test Methods for Tensile Properties of Plastics.
ASTM D 696	Test Method for Coefficient of Linear Thermal Expansion of Plastics
ASTM D 2471	Standard Test Methods for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins.

1.4 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 RESIDENT ENGINEER to ensure continued compliance with these Specifications. The specimens will be made by the RESIDENT ENGINEER.

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2. Compression tests and fabrication of specimens for cement grout and nonshrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the RESIDENT ENGINEER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
 3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the RESIDENT ENGINEER. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.
 4. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the OWNER.
 5. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the RESIDENT ENGINEER in obtaining specimens for testing. However, the CONTRACTOR shall be responsible, without additional cost to the OWNER, for the cost of any additional tests and investigation on work performed which does not comply with the Specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.
- B. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 - Cast-in-Place Concrete, except as modified herein and elsewhere in the CONTRACT DOCUMENTS.

PART 2 -- PRODUCTS

2.1 CEMENT GROUT

- A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4,000 psi.
- B. Cement grout materials shall be as specified in Section 03300 - Cast-in-Place Concrete.

2.2 PREPACKAGED GROUTS

- A. Nonshrink Grout:
 1. Nonshrink grout shall be a prepackaged, inorganic, nongas-liberating, nonmetallic, cement-based grout requiring only the addition of water. The manufacturer's instructions shall be printed

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on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout indicated herein shall be that recommended by the manufacturer for the particular application.

2. Class A nonshrink grouts shall have a minimum 28 day compressive strength of 5,000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD-C 621.
3. Class B nonshrink grouts shall have a minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD-C 621.
4. Application:
 - a. Class A nonshrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is indicated; except, for the applications for Class B nonshrink grout and epoxy grout indicated herein. Class A nonshrink grout may be used in place of Class B nonshrink grout for all applications.
 - b. Class B nonshrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

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

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3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
 4. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.
 5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.
 6. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree F when tested according to ASTM C 531 or ASTM D 696.
 7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications in the CONTRACT DOCUMENTS where grout type is not specifically indicated.
 8. For crack repair, the CONTRACTOR shall use pressure injection epoxy grout as recommended by manufacturer and approved by the RESIDENT ENGINEER.
- C. Grout for Pumps and Motors:
1. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:
 - a. Creep shall be less than 0.005 in/in when tested by ASTM C 881 method. The test shall be at 70 degrees F and 140 degrees F with a load of 400 psi.
 - b. Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17×10^{-6} in/in/degree F when tested by ASTM C 531.

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- c. The compressive strength shall be a minimum of 12,000 psi in 7 days when tested by ASTM C 579 Method 8, modified.
 - d. Bond strength of grout to Portland cement concrete shall be greater than 2,000 psi when using ASTM C 882 test method.
 - e. Grout shall pass the thermal compatibility test when overlaid on Portland cement concrete using test method ASTM C 884.
 - f. Tensile strength and modulus of elasticity shall be determined by ASTM D 638. The tensile strength shall not be less than 1,700 psi and the modulus of elasticity shall not be less than 1.8×10^6 psi.
 - g. Gel time and peak exothermic temperature shall be determined by ASTM D 2471. Peak exothermic temperature shall not exceed 110 degrees F when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.
 - h. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150 degrees F, with a load of 2,000 psi.
- 2. Primer, if required, shall conform to the written recommendations of the grout manufacturer.
 - 3. Surface preparations shall conform to the written recommendations of the grout manufacturer.
 - 4. Placement and Curing:
 - a. Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.
 - b. A grouting performance demonstration/training session shall be conducted by the grout manufacturer's representative prior to foundation and baseplate preparation and the first grouting on site. This training session shall demonstrate proper preparation and installation methods and that the grouting material meets the strength requirements.

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5. Grout shall be Escoweld, Chockfast Red Epoxy Grout as manufactured by Philadelphia Resin Corp., Five Start DP Epoxy Grout as manufactured by Five Star Products, Inc., or equal.

2.3 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 03300 - Cast-in-Place Concrete, shall apply except as noted otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, sitework concrete, as specified in Section 03300 - Cast-in-Place Concrete, may be used when accepted by the RESIDENT ENGINEER.
- C. Coarse aggregate shall be graded as follows:

<u>U.S. Standard Sieve Size</u>	<u>Percent by Weight Passing</u>
2"	100
3/8"	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 30	0

- D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
- E. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3,000 psi.

2.4 CURING MATERIALS

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

2.5 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

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- 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 RESIDENT ENGINEER.
- 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

SECTION 03315 – GROUT

by the RESIDENT ENGINEER, alternate grouting methods shall be submitted for acceptance by the RESIDENT ENGINEER.

C. Topping Grout and Concrete Fill

1. All mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.
2. The minimum thickness of grout topping and concrete fill shall be one inch unless otherwise specified on drawings. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted prior to placing topping or concrete fill. No topping or concrete fill shall be placed until the slab is complete free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping or concrete fill placement. The topping or concrete fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted concrete fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or concrete fill have hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

SECTION 03315 – GROUT

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 concrete units, including connections.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01300 Submittals
 - 2. Section 02150 Sheeting and Shoring
 - 3. Section 05500 Miscellaneous Metals
 - 4. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

ACI 301	Specifications for Structural Concrete for Buildings
ACI 315	Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
ACI 533	Precast Wall Panel
ANSI/AWS A5.4	Welding Rods and Electrodes
ANSI/AWS B2.1	Welding Procedure and Performance Qualifications

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ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.4	Structural Welding Code - Reinforcing Steel
ANSI/AWS D12.1	Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction
PCI MNL-116	Manual for Quality Control for Plants and Production of Precast Concrete
PCI MNL-117	Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
PCI MNL-120	Design Handbook - Precast and Prestressed Concrete
PCI MNL-122	Architectural Precast Concrete
2.	ASTM Standard in Building Codes:
ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 351	Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 497	Specification for Steel Welded Wire Fabric, Deformed for Concrete Reinforcement
ASTM A 580	Specification for Stainless and Heat-Resisting Steel Wire
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

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ASTM A 666	Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A 775	Specifications for Epoxy-Coated Reinforcing Steel Bars
ASTM C 33	Specification for Concrete Aggregates
ASTM C 67	Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 150	Specification for Portland Cement
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 204	Test Method for Fineness of Hydraulic Cement by Air Permeability Apparatus
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 311	Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM D 2240	Test Method for Rubber Property -- Durometer Hardness

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 - Submittals.
- B. Shop Drawings:
 - 1. Shop Drawings shall show details in accordance with ACI 315 and ACI 318 including installation details and design computations.

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2. Shop Drawings and design computations shall be stamped and signed by a Civil or Structural Engineer registered in the State of California.
3. Shop Drawings shall indicate precast unit identification marks, the location of units in the Work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop Drawings shall include erection drawings.
4. Shop Drawings shall be divided into complete separate submittals for each structure. Each complete submittal shall consist of a schedule and shop drawings.
 - a. Schedule: The schedule shall show all exterior plan and elevations of the structure, including all precast concrete enclosure faces exposed to view, in its associated Shop Drawing submittal. Plan and elevations at a minimum scale of $1/8" = 1'0"$ shall be drawn, identifying the type and location of each element by a number which corresponds to the element number appearing on an associated Shop Drawing; this same number shall be permanently marked on the back of each element as they are fabricated.
 - b. Shop Drawings: The Shop Drawings shall show all plan and elevations, dimensions, horizontal and vertical sections, openings, inserts, reinforcing, anchorage devices, details, design computations, and other requirements for each different type of element to be incorporated into the portion of the project covered by the submittal. Drawings shall be 24 inches by 36 inches maximum.
- C. Mix Proportions: Before commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.
- C. 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.

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- D. Certificates of Compliance: Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.
- E. Manufacturer's Qualifications: Before commencing operations, a statement shall be submitted giving the qualifications of the precast concrete Manufacturer, and evidence that the Manufacturer and plant are PCI certified.

1.5 QUALITY ASSURANCE

- A. General Requirements: Design members under direct supervision of a professional Civil or Structural Engineer experienced in design of precast concrete units, registered in the State of California, and conforming to requirements of PCI MNL-120, 122, and to ACI 318.
 - 1. Precast Manufacturer and erectors shall be qualified in accordance with PCI MNL-117 and MNL-116.
 - 2. Welding shall be in accordance with AWS D1.1, AWS D1.4 and AWS A5.4.
 - 3. Manufacture, Transportation and Installation: The Manufacturer shall specialize in providing architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes similar to that indicated on Drawings, using procedures complying with PCI MNL-116 and MNL-11.
 - 4. Certificate of compliance meeting the requirement of Chapter 17 of the current edition of the California Building Code (CBC) of International Conference of Building Officials (ICBO) as adopted by the City of San Diego Municipal Code and acceptance by the City of San Diego shall be submitted to the RESIDENT ENGINEER.
- B. Sample:
 - 1. The CONTRACTOR shall ensure that all precast concrete conforms to requirements for quality and appearance. All precast architectural finishes shall conform in appearance when viewed from a distance of 20 feet to the design, color, and texture. Close-up inspection shall not exhibit any evidence of "bugholes" on exposed surfaces exceeding 1/8-inch and in quantity not more than 2 average per square foot.
- C. Sample Construction:
 - 1. A typical precast concrete combination sectioned wall and related perimeter window assembly shall be constructed. This sample

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construction, after approval, shall serve for comparison as a sample of construction requirements for the rest of the building.

2. The precast concrete units shall structurally support the window assemblies and include anchorage inserts for windows as indicated. Use of drilled-in anchorage inserts for window supports and anchorage of other items is prohibited. Sample construction shall be sealed and finished as required for completed wall.
3. The sample construction shall demonstrate precast concrete units and window framing, sealants, anchorage, and other elements of construction. The sample construction will be inspected and judged for compliance with requirements and visual appearance including uniformity of color and texture, acceptability of patching and repair, and conformance to required tolerances. If the sample does not provide an acceptable window assembly or meet visual appearance or tolerance requirements as determined by the RESIDENT ENGINEER, the CONTRACTOR shall modify, repair, or reconstruct the sample at no additional cost to the OWNER.

1.6 DESIGN REQUIREMENTS

- A. General: The precast concrete panel and connection designs shown represent minimum precast construction requirements. The Manufacturer shall verify the panel and connection designs for all handling, erection, and service conditions, and shall provide any additional materials necessary to meet the design conditions.
- B. Standards and Loads: The precast panel and connection design and construction shall conform to all applicable codes and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. The precast or prefabricated, nonbearing, nonshear wall panels and connections which are attached to or enclose the exterior, shall resist, in addition to initial handling and erection loads and dead loads, the following minimum forces:
 1. Wind, seismic, and load combinations relative to panel design in accordance with CBC.
 2. The design shall be based on a differential temperature of 50 degrees F between interior and exterior faces of the units and an 80 degrees (+40 degrees from erected temperature) average panel temperature differential.
 3. Stresses due to restrained volume changes caused by shrinkage and temperature differentials shall be accounted for.

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- C. Connections: Before submitting shop drawings, verify the precast connection designs against the design criteria and propose any additional materials necessary to meet the design conditions.
1. The panel joints shall be designed to accommodate an in-plane movement between stories of 0.005 times the story height in inches but not less than 3/4 inch.
 2. Panel connections shall accommodate building movement and permit panels to move freely so as not to resist in plane deformation of the main frame structural system. Adjustment shall be provided to accommodate misalignment of structure without permanent distortion, damage to components, racking of joint connection, breakage of seals, or moisture penetration.
- D. Concrete Mix: The concrete mix shall be designed by the Manufacturer and be approved by the RESIDENT ENGINEER, to meet all of the requirements of this specification.
1. Proportioning of Concrete Mixes: Mixes shall be proportioned by weight except water and admixtures may be batched by volume if desired. Trial mixes and testing to meet requirements of the strengths of concrete is the CONTRACTOR's responsibility. Design mix shall contain similar materials as those proposed for use in the Work.
 2. Admixtures: Concrete shall contain an air entraining admixture in proportion so as to provide 4 percent plus or minus 1 percent total air in the concrete as determined by ASTM C 173 or C 231. Set retarding admixtures may be used provided cement content is not reduced. Water reducing admixtures may be used provided they are used in the mix design studies. High-range water reducers (superplasticizers) shall be used only where indicated in this Section, otherwise superplasticizers shall not be used without written approval from the RESIDENT ENGINEER. No admixture may contain chlorides, bromides, or fluorides.
 3. Water: Clean, potable water. Tests to assure that no more than 200 parts per million total aggregated content of chlorides, bromides, and fluorides are present.
 4. If a variance from the Local Authority is required for the precast concrete mix design, the CONTRACTOR shall be responsible for submitting and obtaining the precast concrete mix variance. The admixtures used in the mix design shall be used in approved combinations and proportions in accordance with the local requirements.

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- E. Formwork: Formwork shall be designed to withstand high-frequency vibration and to ensure finished units.
- F. Pickup Points and Boxouts: Pickup points, boxouts, and inserts on panel faces and surfaces to be exposed are prohibited except as approved.

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.
- B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.
- C. Units shall be marked with date of production and final position in structure in a location not visible after erection.
- D. Precast units shall be stored off the ground in a manner to prevent warpage and shall be protected from weather, marring, and overload.
- E. Stainless Steel Hardware: Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type II, "low alkali". "Low alkali" requirement may be waived if not reactive as defined in Appendix to ASTM C 33. Submit laboratory test reports.
- B. Aggregate: ASTM C 33, 1/2-inch max coarse aggregate size fine aggregate ratio to total aggregate volume = 0.35 min, 0.55 max.
 - 1. Water Absorption, Coarse ASTM C 127.
 - 2. Water Absorption, Fine ASTM C 128.
- C. Reinforcing Steel: ASTM A 615, Grade 60, deformed.
- D. Welded Wire Fabric:

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1. Plain: ASTM A 185, epoxy coated.
 2. Deformed Steel: ASTM A 497, epoxy coated.
 3. Fabricated Steel Bar or Rod Mats.: ASTM A 184, epoxy coated.
- E. Tie Wire: ASTM A 580, Type 316L, cold finished annealed, Huntington Alloy Co. "Monel" or "Inconel."
- F. Air Entrainment Admixture: ASTM C 260.
- G. Water Reducing or Retarding Admixtures: ASTM C 494, Type C, D, or F/G, with no chloride, bromide, and fluoride ingredients.
- H. Silica Fume Slurry Admixture: 45 to 50 percent silica fume, water, and superplasticizer as dispersant. Silica Fume: 85 percent amorphous silicon dioxide in accordance with ASTM C 311; loss on ignition shall not exceed 6 percent and moisture shall not exceed 3 percent in accordance with ASTM C 311. Surface area not less than 10,000 square meters per kilogram at bed porosity of 0.50 in accordance with ASTM C 204.
1. Reduce water in mix by 5.6 to 9.5 pounds for each gallon of slurry added to mix, as recommended by slurry Manufacturer used.
- I. Pigment: Pure mineral type, color-resistant to alkalis, nonfading. Color as required to produce finished concrete matching color and appearance of prebid sample and the 72-inch by 72-inch sample at the RESIDENT ENGINEER's field office.

2.2 SUPPORT DEVICES

- A. Connecting and Support Devices: ASTM A 666, Type 316L stainless steel.
- B. Bolts: ASTM A 193, Grade B8M (Type 316).
- C. Nuts and Washers: ASTM A 194, Grade 8M (Type 316).
- D. Weld Filler Metal for Stainless Steel: Stainless steel to stainless steel; AWS A5.4, Grade 316L filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32-inch diameter.
- E. Primer: Zinc-dust, zinc oxide primer in a phenolic resin spar varnish vehicle, TT-P-641 Type III (for galvanized surfaces).

2.3 ACCESSORIES

- A. Plates, Angles, Anchors, and Studs: ASTM A 666, Type 316L stainless steel.

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- B. Austenitic Steel Castings for Embedments and Anchorage Embedments and Anchorage Assemblies: ASTM A 351, Type CF3M, with Type 316 stainless steel bolts, nuts, and washers.
- C. Reglets: Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion.
- D. Bearing Pads: Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D 2240.
- E. Sealant: In accordance with in Section 07920 - Sealants and Caulking.
- F. Hatches and manhole lids: In accordance with in Section 05500, Miscellaneous Metals.

2.4 FORMS

- A. Forms: Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections.
- B. Form Release Agent: Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer.
- C. Surface Sealer: Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by Manufacturer and proved compatible with surface sealer.

2.5 MIX

- A. Silica Fume Concrete: Minimum 5,000 psi, 28-day compressive strength; aggregate 3/8-inch max; water - 305 pounds per cubic yard; cement - 763 pounds per cubic yard; w/c ratio 0.40 maximum; slump range 3 inches to 5 inches with silica fume slurry; air entrainment 4 percent plus or minus 1 percent; 7.5 percent dry silica fume by weight of cement, provided through specified silica fume slurry; add superplasticizer to achieve desired working slump for precast concrete as may be required by silica fume slurry Manufacturer. Add colorant as required to achieve match with RESIDENT ENGINEER's sample. Moist cure by spray mist.

2.6 FABRICATION

- A. General: Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116 (structural features), PCI MNL-117 (nonstructural features, surface treatments, patching, and tolerances). Plant records and quality control program shall be maintained during production of

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precast units. Records and access to plant shall be available to the RESIDENT ENGINEER upon request.

- B. Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.
- C. Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. The maximum amount of damage shall not exceed 2 percent of the surface area of each bar.
- D. Reinforcing steel, anchors, inserts, plates, angles, hatches and lids, and other cast-in-place items shall be embedded as shown on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement is permitted. Welding, when allowed, shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.
- E. Adequate reinforcing steel shall be provided to control cracking. Maximum permissible crack width:

Surfaces exposed to weather:	0.005 inch
Surfaces exposed to view but not weather:	0.01 inch
- F. Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment. Hatch and manhole lid sizes and types should be shown on the Drawings. Component requirements are stated in the Miscellaneous Metals specification,
- G. Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during panel construction. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.
- H. Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.
- I. Precast units shall be removed from formwork using procedures conforming to PCI MNL-117. Minor patching in plant is acceptable, providing structural adequacy and appearance of units are not impaired. Each precast unit shall

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be identified with corresponding code on erection drawings, on a location not visible.

- J. Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.
- K. Fabrication and Tooling of Stainless Steel Connections and Embedments: All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.
- L. Welding of stainless steel shall conform to AWS A5.4, AWS B2.1 and AWS D1.1, using tungsten inert gas procedures and 316L filler metal for stainless steel to stainless steel and 309 filler metal for stainless steel to carbon steel. Surfaces shall be sanded smooth (do not grind), and oxidized discoloration shall be removed (blue heat tint). Threaded parts of stainless steel bolts shall be lubricated with graphite suspended in alcohol (Neo-Lube) every time that nut is run on or off the threads. No other lubricant is acceptable.
- M. Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.7 FINISH OF PRECAST UNITS

- A. Unexposed Faces. Smooth, dense, uniform surface free from blemishes. Defects in unexposed edges shall be repaired as approved.
- B. Exposed Faces (Requiring Architectural Treatment): Appearance, color, and texture finish of all panels shall match appearance, color and texture of the approved sample panels constructed by the CONTRACTOR. Panels that do not match will be rejected. Repairs will be acceptable only if structural adequacy and appearance of product are not impaired and the repair and surrounding area match the approved sample panels.
- C. Mechanical finishing of panels at precast plant shall be at essentially the same age and strength of concrete to assure finished appearance is uniform from panel to panel.
- D. To reduce possibility of stains occurring during transportation and erection, sealer shall be applied at the plant as recommended by Manufacturer and the precaster and shall be guaranteed in writing that sealer will not alter or yellow the original precast concrete color in any way and that it is compatible with the joint sealants to be used on the project. Seal finish surfaces of precast units to be exposed in completed work as follows: apply a uniform coat of surface sealer in accordance with Manufacturer's written instructions. Apply sealer by method and in quantity required to provide coverage specified by sealer Manufacturer. Forty-eight hours after application of sealer, apply water to face of each panel in sufficient quantity to determine if full sealer coverage

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was achieved. Panels not fully sealed shall be resealed and retested. A second coat shall be applied at the jobsite after erection and cleanup in accordance with the Manufacturer's instructions.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Examination: Verify that building structure, anchors, devices, and openings are ready to receive work of this Section. Beginning of installation means acceptance of existing condition.
- B. Preparation: Plan for erection procedures and induced loads during erection, maintain temporary bracing in place until final support is provided, and provide necessary hoisting equipment and safety and protective devices.
- C. Erection: The units shall be erected in accordance with approved shop/erection drawings without damage to shape or finish or adjacent work. Damaged panels shall be replaced or repaired. Unless otherwise indicated, members shall be erected level and plumb within allowable tolerances.
- D. The CONTRACTOR shall align and maintain uniform horizontal and vertical joints as erection progresses, provide approved shims and wedges as required, and when members require adjustment beyond design or tolerance criteria, discontinue affected work. Units shall be secured in place and field welds, scratches, and otherwise damaged steel surfaces shall be touched up.
- E. Field fabrication and erection of stainless steel shall conform to the procedures outlined in the paragraph entitled "Fabrication and Tooling of Stainless Steel Connectors and Embedments."
- F. Vertical units shall be set dry, without grout; attain joint dimensions with lead or plastic shims and spacers.
- G. Pickup points, boxouts, inserts and bearing surfaces shown shall be grouted with non-shrink grout in accordance with Section 03315 - Grout. The color and texture of concrete surfaces of adjacent areas shall be finished to match in the same plane.
- H. Tolerances: In accordance with requirements of PCI MNL-117 unless otherwise indicated.
 - 1. Variation from Plane of Location: 1/4 inch in 10 feet and 3/8 inch in 100 feet maximum, compensating not cumulative.
 - 2. Offset from True Alignment between Two Connecting Members: 1/4 inch maximum.
 - 3. Out of Square: 1/8 inch in 10 feet maximum, noncumulative.

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4. Variation in Dimensions Indicated in Shop Drawings: Plus or minus 1/8 inch.
 5. Misalignment of Anchors, Inserts, Openings: 1/8 inch, maximum.
 6. Bowing or Warpage of Units: 1/700 of panel dimension.
 7. Exposed Joint Dimension: 3/4 inch plus or minus 1/8 inch.
 8. Location of Reglets: 1/4 inch from true position.
- I. Joint Sealing: In accordance with Section 07920 - Sealants and Caulking.

3.2 CLEANING

- A. Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast units shall be cleaned using a cleaning detergent recommended by the sealer manufacturer and water applied with a soft bristle brush, and thoroughly rinsed using clean water or other approved procedures.
- B. Units shall be cleaned when temperature and humidity conditions are such that surfaces dry rapidly (e.g., 70 degrees F and rising, 50 percent RH or less).
- C. Discolorations which cannot be removed by these procedures shall be considered defective work, and shall be repaired or replaced as directed by RESIDENT ENGINEER.

3.3 PROTECTION

- A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration, or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

**** END OF SECTION ****

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 01300 Submittals
 - 2. Section 02150 Sheeting and Shoring
 - 3. Section 02200 Earthwork
 - 4. Section 03200 Reinforcement Steel
 - 5. Section 03300 Cast-in-Place Concrete
 - 6. Section 06100 Rough Carpentry
 - 7. Section 07100 Waterproofing

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

8. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the California Building Code (CBC) and the Masonry Standards Joint Committee Code (MSJC) as adopted by the City of San Diego Municipal Code.
- B. Commercial Standards (Current Edition)
1. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
 2. ACI 531 Building Code Requirements for Concrete Masonry Structures
- C. ASTM Standards in Building Codes (Current Edition)
1. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 2. ASTM C 5 Specification for Quicklime for Structural Purposes
 3. ASTM C 55 Building Brick, Concrete
 4. ASTM C 90 Specification for Hollow Load-Bearing Concrete Masonry Units
 5. ASTM C 140 Method of Sampling and Testing Concrete Masonry Units
 6. ASTM C 144 Specification for Aggregate for Masonry Mortar
 7. ASTM C 145 Solid Load-Bearing Concrete Masonry Units
 8. ASTM C 150 Specification for Portland Cement
 9. ASTM C 207 Specification for Hydrated Lime for Masonry Purposes
 10. ASTM C 270 Specification for Mortar for Unit Masonry
 11. ASTM C 404 Specification for Aggregates for Masonry Grout
 12. ASTM C 426 Test Method for Drying Shrinkage of Concrete Block
 13. ASTM E 476 Grout for Reinforced and Nonreinforced Unit Masonry

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

14. ASTM E 447 Test Method for Compressive Strength of Masonry Prisms

1.4 SUBMITTALS

- A. Samples of concrete masonry unit colors with texture ranges as indicated shall be submitted to the RESIDENT ENGINEER 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 RESIDENT ENGINEER 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 RESIDENT ENGINEER.
- B. A 4-foot minimum square free-standing sample panel shall be prepared for approval by the RESIDENT ENGINEER before starting masonry Work and shall remain at the Work site for reference until all masonry Work is completed.
- C. Concrete Masonry Unit. Provide certificate for material from the manufacturer which includes compression strength test data.
- D. Mortar. Provide material certificate from the manufacturer which includes compression strength test.
- E. Grout. Provide mix design and current 28-day compression test results.

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 RESIDENT ENGINEER'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 RESIDENT ENGINEER to ensure compliance with the Specifications and the governing codes. Test reports shall be submitted to the RESIDENT ENGINEER 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.

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

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 RESIDENT ENGINEER.
 4. Additional samples and tests may be required whenever, in the judgment of the RESIDENT ENGINEER, 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 RESIDENT ENGINEER, 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 RESIDENT ENGINEER or the testing laboratory. Tests shall be in accordance with the CBC and ASTM 270 for mortar. The grout and mortar strengths shall be not less than the minimum strengths indicated herein.
- H. Inspection: Continuous inspection by a special inspector approved by the City of San Diego Building Department and by the RESIDENT ENGINEER will be required where necessary to conform with code requirements. Costs of special inspection shall be paid for by the CONTRACTOR. Inspection reports shall be submitted.
- I. Weather Conditions: Concrete masonry units shall not be placed when air temperature is below 40 degrees F and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F in the shade with relative humidity less than 50 percent.
- J. Product Storage: Cement, lime, and other cementitious materials shall be delivered to the site and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Masonry Design Manual. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30 pounds per square foot. Masonry materials shall be protected

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

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 shall be 8-inch by 8-inch by 16-inch modular size, with split faces. Retaining wall to have split faces on both sides. The color of concrete masonry units shall be selected by the RESIDENT ENGINEER.
- C. 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.
- D. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.
- E. Concrete masonry units at interior walls shall be medium weight precision block 8-inch by 8-inch by 16-inch modular size of color matching the adjacent block.

2.2 MATERIALS FOR MORTAR AND GROUT

- A. Portland cement shall be Type II, low alkali, conforming to ASTM C 150.
- B. Lime paste shall be made with pulverized quicklime, or with hydrated lime, which shall be allowed to soak not less than 72 hours before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hours and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C 207. Pulverized quicklime shall conform to ANSI/ASTM C 5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.
- C. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.
- D. Water for mixing shall be clear potable water.
- E. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60.

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

- F. Admixture for mortar shall be Master Builders "PS-235 or Rheomix-235"; Sika Co., "Sika Red Label," or equal. The admixture shall not be detrimental to the bonding or help the process of efflorescence.
- G. Admixture for grout shall be Sika Co., "Sika Grout Aid," Type II; Master Builders "Pozzolith" normal; or equal.

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 2,000 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 2,500 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 RESIDENT ENGINEER. When it has been approved for use, it shall be used in accordance with the manufacturer's published recommendations for the grout.

3.4 CONSTRUCTION - GENERAL

- A. All Work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.
- B. Set or embed all anchors, bolts, reglets, sleeves, conduits, and other items in Work as required.
- C. All block cutting shall be by machine.

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

- 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.

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

3.7 MIXING

- A. Mortar shall be mixed by placing 2 of the water and sand in the operating mixer, following which the cement, lime, and remainder of the sand and water shall be added. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

3.8 ERECTION OF CONCRETE BLOCK MASONRY

- A. Masonry Work shall be erected in-plane, plumb, level, straight, and true to dimensions shown and executed in accordance with acceptable practices of the trade.
- B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.
- C. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be full bedded in mortar. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

3.9 SHORING AND BRACING

- A. All shoring and bracing shall be provided as required for work. Shoring and bracing shall be constructed to required shapes and sizes, capable of supporting and sustaining the loads to which they will be subjected without failure or deflection. Shores and bracing shall be left in place until concrete masonry can safely carry all required live and dead loads.
- B. Concrete masonry wall shall be adequately braced to withstand all forces to which they will be subjected during construction. Walls are not designed to be self-supporting for lateral loads until attached to floor and roof elements.

3.10 JOINTS

- A. Vertical and horizontal joints shall be uniform and approximately 3/8 inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior nonexposed masonry and masonry behind plaster shall have flush joints.

3.11 CLEANOUTS

- A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft in height. Any

SECTION 04232 – REINFORCED CONCRETE BLOCK MASONRY

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 RESIDENT ENGINEER, 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.

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- 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 RESIDENT ENGINEER.

**** END OF SECTION ****

SECTION 05120 – STRUCTURAL STEEL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide structural steel beams, columns, bracings, galvanizing, and appurtenances, complete, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections apply to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of the Work.
- B. Related Work Specified in Other Sections.
 - 1. Section 01300 Submittals
 - 2. Section 05500 Miscellaneous Metals
 - 3. Section 03200 Reinforcement Steel
 - 4. Section 09800 Protective Coating, except touch-ups of damaged shop coats
 - 5. Steel supports, hangers, brackets and other miscellaneous items accessory to the mechanical and electrical installations, and indicated or detailed on the Drawings and in Divisions 15 and 16

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The current edition of the California Building Code (CBC) as adopted by the City of San Diego Municipal Code.
- B. Commercial Standards (Current Edition):
 - 1. AISC M011 Manual of Steel Construction for Shop and Field Welding
 - 2. AISC S326 Design, Fabrication and Erection of Structural Steel for Buildings
 - 3. AWS-B3.0 Welding Procedures and Performance Qualifications
 - 4. AWS-D1.1 Structural Welding Code - Steel
 - 5. AWS-W1 Welding Metallurgy

SECTION 05120 – STRUCTURAL STEEL

- C. ASTM Standards in Building Code (Current Edition):
1. ASTM A6 General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
 2. ASTM A36 Structural Steel
 3. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B
 4. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 5. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
 6. ASTM A325 High Strength Bolts for Structural Steel Joints
 7. ASTM A490 Heat-Treated Structural Steel Bolts
 8. ASTM A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

1.4 SUBMITTALS

- A. The CONTRACTOR shall furnish submittals to the RESIDENT ENGINEER for review in accordance with Section 01300 - Submittals.
- B. Shop Drawings and Erection Drawings: The shop drawings shall provide a materials and specification list, construction and fabrication details, layout and erection diagrams, and the method of anchorage to adjacent construction. The shop drawings shall give the location, type, size and extent of welding and bolted connections, and clearly distinguish between shop and field connections. Before submittal of the shop drawings, the CONTRACTOR shall coordinate the shop drawings and related trades to ensure proper mating of assemblies. All work shall conform to the approved shop drawings.
- C. Test Reports: The CONTRACTOR shall furnish certified physical and chemical mill test reports for material used for structural members. All tests shall be performed in accordance with applicable ASTM Standards.
- D. Shop Painting Data: In coordination with the requirements of Section 09800 - Protective Coating, the CONTRACTOR shall submit a product list with product data sheets of intended shop coats, which for reasons of compatibility, shall be the same products and manufacturer as those of deferred field-applied systems intended to be used in work of Section 09900 - Architectural Paint Finishes.

SECTION 05120 – STRUCTURAL STEEL

1.5 DELIVERY

- A. The Fabricator shall deliver the fabricated material to the job site in the sequence as approved by the RESIDENT ENGINEER.
- B. All shipped material to be piece-marked for erection with metal tags or other appropriate method approved by the RESIDENT ENGINEER.
- C. All material shipments shall include sufficient bolts for erection, plus at least the following extra bolts:
 - 1. Add a minimum of 2% for high strength bolts.
 - 2. Add a minimum of 5% for unfinished bolts.
- D. The RESIDENT ENGINEER reserves the right to inspect fabricated material at Fabricator's shop. The RESIDENT ENGINEER's expenses for shop expenses will be borne by the OWNER. In the event the RESIDENT ENGINEER identifies faulty materials or workmanship in fabricated material at the Fabricator's shop, the costs of additional inspections shall be borne by the CONTRACTOR. The RESIDENT ENGINEER shall be notified at least 7 days before the shipment of material. Shipments of material shall not be deleted if the RESIDENT ENGINEER does not require inspection.
- E. Material damaged in shipment shall be replaced or repaired at the CONTRACTOR's expense at no additional cost to the OWNER.

1.6 QUALITY ASSURANCE

- A. The CONTRACTOR shall fabricate and erect structural steel work in accordance with the latest edition of AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except whenever there is a discrepancy between the Drawings and this Section, the Drawings will govern.
- B. Continuous Inspections:
 - 1. The CONTRACTOR shall perform all welding and high strength bolting of structural steel assemblies under continuous inspection of an ICC-certified Special Inspector selected by the OWNER with the costs borne by the OWNER. Should such fabrication be performed in the shop of a licensed Fabricator approved by the governing Building Official and certified by ICC, 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.
 - 2. The CONTRACTOR shall notify the RESIDENT ENGINEER at least 24 hours in advance of the needed inspection.

SECTION 05120 – STRUCTURAL STEEL

3. The CONTRACTOR shall provide copies of inspection reports to the RESIDENT ENGINEER and Building Department.

1.7 WARRANTY

- A. The Fabricator shall furnish a warranty to the OWNER to replace or repair all defective material and workmanship within 18 months of shipment, or 12 months of plant startup, whichever occurs first, excluding defects due to normal usage.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. General. All materials shall be new, sound and conform to the requirements herein. Unless otherwise indicated, structural steel shall be galvanized.
- B. Structural Steel: Rolled shapes, plates and bars shall conform to the latest edition of the AISC "Manual of Steel Construction", and shall also conform to current ASTM Designation indicated on the Drawings.
- C. Pipe: Pipe shall conform to ASTM A53, Grade B seamless galvanized as required, Schedule 40, except as otherwise shown on the Drawings.
- D. Tubes: Tubes shall conform to ASTM A500 Grade B (Fy = 46ksi).
- E. High Strength Structural Bolts: Bolts, nuts and washers shall conform to ASTM A325, unless otherwise noted on the Drawings.
- F. Welding Electrodes: The CONTRACTOR shall use steel electrodes conforming with AWS D1.1, except that E7024 rods or electrodes shall not be used.
- G. Galvanizing
 1. Iron and Steel. ASTM A123, with an average weight of 2.0 ounces per square foot, and not less than 1.8 ounces per square foot.
 2. Ferrous Metal Hardware Items. ASTM A153 with average weight of 1.3 ounces per square foot.
 3. Touch-up Material for Galvanized Coatings. The CONTRACTOR shall repair galvanized coatings marred or damaged during erection or fabrication by use of Drygalv, as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or equal, applied in accordance with the manufacturer's instructions.
- H. Patch Coat for Galvanized Surfaces. The CONTRACTOR shall patch all galvanized surfaces which are scratched, marred, or otherwise damaged with

SECTION 05120 – STRUCTURAL STEEL

Kop-Coat's Carbo Zinc 11, Drygalv" by American Solder and Flux Co., Ruse-Oleum 2185 Cold Galvanizing Compound, Glidden's Glid Zinc organic 5526/5527/5528, Mobil 13F1180, Sherwin-William's Zinc Clad I (Low VOC) B69AW9, Tnemec 90-97, or equal.

2.2 FABRICATION

- A. Fabrication shall be in accordance with AISC S326 and indicated requirements. All structural steel welding in off-site fabrication shops shall be continuously inspected by a City of San Diego Certified Special Inspector with the inspection cost of the Special Inspector to be borne by the CONTRACTOR. The continuous inspection will be waived if the work is done in a shop certified by the AISC and approved by the City of San Diego.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General
1. Structural assemblies and shop and field welding shall meet the requirements of AISC M011 and AISC S326.
 2. Measurements and dimensions shall be verified at the site.
 3. Bolt holes shall be 1/16 inch larger than the nominal size of bolts. Where thick metals are indicated, holes shall be sub-punched and drilled, or reamed.
 4. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.
 5. Bolts shall not be permitted to drift, and holes shall not be enlarged to correct misalignment. In the event of mismatching of holes, new materials shall be provided.
 6. Structural steel completely encased in concrete shall not be galvanized or painted, and shall have a clean surface for bonding to concrete.
 7. Damaged structural steel shall be replaced. Use of salvaged, reprocessed, or scrap materials shall not be permitted.
- B. Welding: Welding shall be performed by operators who have been qualified by tests as prescribed by AWS-W1 Section 7, to perform the type of welding indicated. Welding shall comply with AWS Code for Arc Welding in Building Construction, Section 4, Workmanship. Electrodes shall be matching per AWS.

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- C. Galvanizing: All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A123. Any galvanized part that becomes warped during the galvanizing operation, shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A153. Field repairs to galvanizing shall be made using "Galvinox", "Galvo-Weld, or equal.
- D. Painting: The CONTRACTOR shall give one or more shop coats of paint on all structural steel, except galvanized metals. Before priming, the CONTRACTOR shall thoroughly clean surfaces. The CONTRACTOR shall allow shop coats to dry before materials are loaded for delivery to the job site. After erection, the CONTRACTOR shall paint all areas where the shop coats have been rubbed off or omitted, and all field bolting and welding as specified for shop priming. The CONTRACTOR shall perform surface preparation, prime coatings, finish painting and coatings in accordance with Section 09800 - Protective Coating.

3.2 INSPECTION

- A. The OWNER reserves the right to inspect all materials and workmanship covered in this Specification. However, such inspection shall not relieve the CONTRACTOR of his responsibility to furnish materials and workmanship in accordance with the Contract requirements. If inspection indicates a weld or part of the material is defective, the CONTRACTOR shall remove and replace it at the CONTRACTOR's expense.
- B. Shop inspection may include, but not be limited to, the following:
 - 1. Verification of conformance of materials with this Specification and the Drawings. The limits of acceptability and repair of surface imperfections for structural steel shall be in accordance with ASTM A-6.
 - 2. Visual and dimensional inspection of shop-fabricated structural steel members and assemblies shall be in conformance with this Specification and the Drawings.
 - 3. Inspection of high strength bolted connections shall be in accordance with AISC "Specification for Structural Joints Using ASTM A-325 or A-490 Bolts".
 - 4. Verification of welding procedures, welding operations, and welder and tacker certificates of qualification shall be in accordance with this Specification and AWS D1.1.

**** END OF SECTION ****

SECTION 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 stairs.
 - 3. Grating stair treads and nosing.
 - 4. Safety stair nosing for concrete stairs.
 - 5. Ladders.
 - 6. Steel pipe handrailing.
 - 7. Metal grating with incidental supports and attachments.
 - 8. Checkered plate.
 - 9. Hatches.
 - 10. Iron castings.
 - 11. Steel channels and/or angle frames and thresholds with anchors.
 - 12. Welding electrodes.
 - 13. Shop prime paint.
 - 14. Pipe supports with saddles, hangers, bracing and attachments as detailed and required, except as provided by other trades.
 - 15. Guard post assemblies of removable and stationary types.
 - 16. Miscellaneous iron and steel items indicated, specified, or required for completion of the Contract, unless included under other Sections.
 - 17. Warning signs.
 - 18. Galvanizing and shop primer finishes, including field touch-up.

SECTION 05500 – MISCELLANEOUS METALS

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 01300 Submittals
 2. Section 07720 Roof Accessories
 3. Section 07721 Rooftop Fall Protection
 4. Section 09800 Protective Coating
 5. Section 15000 Piping Components
 6. Section 16500 Lighting
 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 Regional and 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 Federal Specifications apply to the Work of this Section:
1. QQ-F-461 Floor Plate, Steel, Rolled
 2. MIL-G-18015 A (Ships) Aluminum Planks. (6063-T6)
 3. MIL-A-907E Antiseize Thread Compound, High Temperature
- D. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
1. Commercial Standards:
AA-M32C22A41 Aluminum Association

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AASHTO	HS-20 Truck Loading
AISC	Specification for Design, Fabrication and Erection of Structural Steel for Buildings with Commentary and Code of Standard Practice for Steel Buildings and Bridges
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Specification for Qualification and Certification of Welding Inspectors
NFPA 101	Life Safety Code
NAOMM	Metal Stairs Manual
AWS-AS	Welding of Stainless Steel with Electrodes and Techniques
2.	ASTM Standards in Building Codes:
ASTM A36	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A125	Specification for Steel Springs, Helical, Heat Treated
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

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ASTM A193	Specification for Alloy-Steel and Stainless steel Bolting Materials for High-Temperature Service
ASTM A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
ASTM A276	Specification for Stainless Steel Bars and Shapes
ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A320	Specification for Alloy-Steel Bolting Material for Low-Temperature Service
ASTM A424	Specification for Steel, Sheet, for Porcelain Enameling
ASTM A500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A536	Specification for Ductile Iron Casting
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM A569	Specification for Steel, Carbon (0.15 Maximum Percent), Hot Rolled Sheet and Strip Commercial Quality
ASTM A575	Specifications for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A786	Specification for Rolled Steel Floor Plates
ASTM B98	Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

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ASTM B221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B438	Specification for Sintered Bronze Bearings (Oil-Impregnated)

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Miscellaneous metals shall be fabricated and erected in accordance with the latest edition of the AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except whenever there is a discrepancy between the design drawings and this specification, the Drawings shall govern.
- B. Aluminum work shall be fabricated and erected in conformance with applicable requirements of the CBC and referenced standards of the Aluminum Association.
- C. Continuous Inspections: All welding and high strength bolting of structural steel assemblies shall be conducted under the continuous inspection of an International Code Council (ICC) certified "Special Inspector" selected by the RESIDENT ENGINEER with costs borne by the OWNER. Should such fabrication be performed in the shop of a licensed fabricator approved by the governing building official and certified by the 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 RESIDENT ENGINEER shall be notified at least 24 hours in advance of needed inspections. Copies of inspection reports for shall be provided for the RESIDENT ENGINEER, CONTRACTOR, and governing building official.

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PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Steel: Steel shall conform to the following requirements:
1. Shapes, Plates, Bars ASTM A 36 unless otherwise indicated on the Drawings
 2. Pipe, Pipe Columns, Bollards ASTM A 53, Type E or S, Grade B Schedule 40, unless noted otherwise
 3. Tubes ASTM A 500, Grade B
- B. Aluminum: Aluminum structural shapes shall be new and conform to applicable Federal Specification for 6061-T6 alloy, unless otherwise noted. Aluminum Pipe shall conform to Schedule 40, or greater.
- C. Stainless Steel: Unless otherwise designated or approved, stainless steel alloy types shall conform to ASTM A167 and ASTM A276 as follows:
1. Stainless steel plates, pipe and structural shapes: Type 316L.
 2. Stainless steel bolts, nuts and washers: Type 316L where connecting or bearing on aluminum.
- D. Cast Iron: Cast iron shall conform to ASTM A48, except as otherwise noted.
- E. Ductile Iron: Ductile iron shall conform to ASTM A536, using Grade 60-40-18 or better, except as otherwise noted.

2.2 STEEL PIPE HANDRAILS

- A. Steel Pipe Handrails: Steel pipe handrails, including brackets and related hardware, which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316L stainless steel. All other steel pipe handrails shall be standard 12-inch black steel pipe made up by welding. All steel pipe handrail shall be picked at fabrication plant and shall be hot-dip galvanized after fabrication.

2.3 METAL STAIRS

- A. Metal Stairs: Metal stairs shall be composed of stainless steel, steel or aluminum stringers and supports as indicated on the Drawings, and shall be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers. Steel stair members shall be hot-dip galvanized after fabrication.

2.4 GRATING STAIR TREADS

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- A. Grating stair treads shall be designed to support a live load of 100 psf or a concentrated load at mid-span of 1,000 pounds, whichever creates the higher stress. The maximum deflection due to the uniform live load shall be as required for grating elsewhere in this Section. All grating stair treads shall have an integral nonslip nosing.

2.5 SAFETY STAIR NOSINGS

- A. Safety stair nosing shall be provided on all concrete stairs and other locations indicated. The nosing shall be 4-inch wide, extruded aluminum with cast-in abrasive strips and integral extruded anchors. The color of the cast abrasive will be selected by the OWNER from the manufacturer's standard colors.

2.6 LADDERS

- A. Ladders: Ladders which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316 stainless steel. All other ladders shall be of aluminum or carbon steel, hot-dip galvanized after fabrication, or as indicated.
- B. Pop-Up Extensions: Ladders that do not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.
- C. Fall Prevention Systems: The fall prevention system shall be provided for ladders used to ascend heights exceeding 20 feet unless otherwise indicated on the Drawings. All necessary components shall be provided, including 2 safety belts for each fall prevention installation to provide a complete and fully operational fall prevention system. A rail extension shall be provided for each installation. At all locations where fall prevention systems are installed, a safety chain with a snap hook shall be permanently attached to the top of the ladder. The chain shall be long enough to allow a person to connect the belt to the chain while standing on the landing adjacent to the ladder. The chain and snap hook shall have a minimum allowable capacity of 500 pounds. Safety belts shall fit a waist range from 23 inches to 54 inches. Safety rails and associated accessories shall match the ladder material.

2.7 METAL GRATING

- A. General: Metal grating shall be of the design, sizes, and types indicated. All grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded

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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. Except where indicated otherwise, bar grating shall be fabricated entirely of aluminum. Bearing and banding bars shall be Alloy 6061-T6; cross bars shall be Alloy 6063-T5.
2. Safety grating shall be fabricated of Aluminum Alloy 5052-H32.
3. Grating which may be partially or wholly submerged shall be fabricated entirely of Type 316 stainless steel.

C. Standard-Duty Grating:

1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.
2. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.

D. Safety Grating: Safety grating shall be made of sheet metal punched into an open serrated diamond pattern and formed into plank sections. The open diamond shapes shall be approximately 1-7/8 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.

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- F. Plank Grating:
1. Plank grating shall be aluminum alloy 6063-T6 extruded in 6-inch widths with a minimum of six integral 1-bar type-bearing bars per plank. The top surface shall be solid with raised ribs, unless noted otherwise. Where punched grating is required, the top surface shall be provided with a pattern of 3 inch by 19/32 inch rectangular openings spaced at 4 inches on center. The planks shall have continuous tongue and groove type interlock at each side.
 2. Plank grating shall be provided with a clear anodized finish, except that punched grating may have standard mill finish.
- G. Grating Fastening Devices: For metal gratings, either welded or mechanical attachments shall be used except where otherwise noted for locations such as stair treads and incidental landings. For aluminum grating, attachments shall be fabricated of Type 18-8 austinitic stainless steel.

2.8 CHECKERED PLATE

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

2.9 HATCHES

- A. Hatch Type: Where access hatches are indicated to be mounted on a floor slab (including top slabs which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein. Hatches mounted on a roof surface which has a membrane or other roofing material covering it shall be the integral raised curb type as indicated in Section 07720 - Roof Accessories.
- B. Hatch Materials: All hatches shall be fabricated from Type 304 stainless steel unless otherwise indicated. All hatch hardware shall be Type 316 stainless steel.
- C. Live Loads: The minimum design live load shall be 300 psf unless otherwise indicated on the Drawings. The minimum design live load for vehicular traffic

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loading as indicated on the Drawings shall be MS-20 truck loading in conformance with the current AASHTO standard specification.

- D. Hatch Dimensions: Hatch opening sizes, number and direction of swing of door leaves, and locations shall be as indicated. Sizes given shall be for the clear opening. Where the number of leaves is not given, openings larger than 42 inches in either direction shall have double-leaf doors. Unless indicated otherwise, hinges shall be located on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension, and the door hinge opposite the ladder.
- E. Hatch Doors: Door leaves shall be a minimum of 3-inch raised lugs of diamond shape pattern checkered plate. Channel frames shall be a minimum of 3-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Equip doors with heavy forged bronze hinges, stainless steel pin and spring operators for ease of operation by a single person. Hatches shall be designed for easy opening from both inside and outside.
- F. Water Tightness: Hatches shall be designed to be water-tight and shall be equipped with a joint gutter and moat-type edge drain. A 1.5-inch diameter (minimum) drain connection shall be provided and located by the manufacturer.

2.10 IRON CASTINGS

- A. General: Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shotblasting.
- B. Covers and Grates: Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
- C. Design Loads: Covers and grates with matching frames shall be designed to support the following loadings:
 - 1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no loading is given, a minimum of 300 pounds per square foot, unless indicated otherwise.
 - 2. Exterior covers and grates shall be designed for AASHTO H20 loading unless indicated otherwise.

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- D. Cover Details: Unless indicated otherwise, access manway covers shall be two-part street type removable covers. Larger cover shall be for a 48-inch diameter clear opening with 24-inch diameter cover offset from the center as indicated. Raised lettering shall be as indicated.

2.11 CAST-IN-PLACE THRESHOLD

- A. Threshold: The cast-in-place threshold at overhead roll-up doors shall be a steel threshold embedded in the concrete floor slab. The threshold shall be the product of Eastern Metal Products Co., Elizabeth City, NC (telephone: (919) 335-5451); or equal.

2.12 GALVANIZING

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

2.13 WELDING ELECTRODES

- A. Steel Electrodes: Welding electrodes shall conform with AWS D1.1, except E7024 rods or electrodes shall not be used.
- B. Aluminum Electrodes: Contingent upon alloys being welded, only inert gas-shielded arc or resistant-welding process with filler alloys conforming to UBC Standard No. 28, Table 28-1-C shall be used. No process requiring a welding flux shall be used.
- C. Stainless Steel Electrodes: Welding of stainless steel with electrodes and techniques shall conform to the pertinent AWS A5 series specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

2.14 BOLTS

- A. Bolt Requirements: Bolts shall comply with the following:
 - 1. Nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

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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 A325, or threaded parts of ASTM A36. ASTM A325 bolts and nuts shall not be galvanized.

C. Bolts Buried or Inside Tanks or Channels: Unless otherwise indicated, bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.

2.15 SHOP PRIME PAINT

A. Shop Prime Paint: To ensure compatibility with deferred field-applied paint or coating systems, for ferrous metals other than stainless steel, galvanized steel and cast iron, provide surface preparations, and use shop prime paint product and manufacturer as painting, or protective coating system intended for field application specified in Section 09800 - Protective Coating. Shop prime shall not be provided on portions of work immediately adjacent to intended field welds, 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.

2.16 MANUFACTURERS

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

1 Steel Gratings:

a. Irving Type IWA

b. Gary Type GW

2. Floor and Cover Plates:

a. Alcoa C-102 Aluminum Tread Plate

b. Reynolds Diamond Tread Plate

3. Floor Hatches:

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- a. Babcock Davis
 - b. Bilco Company
 - c. Inryco-Milcor
 - d. Milcor
4. Safety Stair Nosings:
- a. Wooster Products, Incorporated Alumogrit, Type 101
 - b. American Abrasive Metals Company Alumalum, Style A
 - c. Safe-T-Metal Company Incorporated Style AX
5. Fall Prevention System:
- a. Research and Trading Corporation, Wilmington, Delaware Everest Lifeline System Model No. 6006
 - b. North Consumer Products, Inc., California Saf-T-Climb
6. Manhole Frames and Covers:
- a. Neenah Foundry Company R-1642 with Self-Sealing Cover
 - b. Phoenix Iron Works P-1090 R/G
7. Field Repairs to Galvanizing:
- a. "Galvinox"
 - b. "Galvo-Weld"
8. Aluminum Grating:
- a. Gary Galok
 - b. Seidelhuber

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

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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 RESIDENT ENGINEER. The CONTRACTOR shall repair or replace all damaged or defective work to original specified condition at no additional cost to the OWNER.
1. Finished floor surfaces and adjacent work shall be protected from damage. Concrete floors shall not be overloaded. Mobile equipment used in placing steel shall have pneumatic tires. Steel members shall not be placed directly on floors; pads of timber or other material shall be used for cushioning.
 2. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.
- C. Hatches: Unless otherwise indicated, the CONTRACTOR shall furnish and install a 1/2-inch drain line to the nearest floor drain for all floor hatches.
- D. Ladders: Bracketed units of steel or aluminum shall be fabricated as shown on the Drawings. Ladder fabrication shall conform to requirements shown on the Drawings, and CAL/OSHA (and/or OSHA). Aluminum units shall have a flaw-free polish finish. Rails shall be extended where indicated. Aluminum units shall be secured with stainless steel anchoring devices. Fall prevention systems shall be provided on all ladders used to ascend heights exceeding 20 feet unless otherwise indicated on the Drawings.
- E. Pipe Rails and Railings: Pipe rails and railing shall be fabricated complete with -stanchions, toe plates, welded and bolted fittings, attachments and expansion/contraction provisions true to size configurations to meet or exceed the requirements of CAL/OSHA, and as shown on the Drawings. The CONTRACTOR shall grind and polish welds flush and smooth. Curves, where indicated or necessary, shall be bent on a radius of not less than 5 inches.

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1. Safety chains shall be 1/2-inch link chain of same material as the railing with stainless steel harness-type snap to meet or exceed the requirements of CAL/OSHA.
 2. Provisions shall be made to drain water from rail systems by drilling weep holes in concealed locations at the lowest possible elevations.
- F. Pipe and Conduit Supports and Bracing: Supports and bracing for pipe and conduit shall be fabricated and installed as detailed on the Drawings, and in accordance with the requirements described in Section 15020 - Pipe Supports, in a fully coordinated manner with the Work of other trades. Where shown or indicated, hot-dip galvanized shall be provided after fabrication, with touch-up of abraded or burned galvanizing using materials specified in this Section. Unless otherwise indicated, members shall be shop primed with a rust-inhibitive primer conforming with requirements of Section 09800 - Protective Coating.
- G. Embedded Steel Channel and Angle Frames: Embedded steel channel and angle frames shall have continuously welded joints. Exposed welds shall be ground flush. Hot-dip galvanizing shall be provided after fabrication.
- H. Warning Signs: Warning signs shall be furnished and installed in the locations specified below. Provide signs that are not less than designated sizes. Fabricate signs of porcelain enamel safety blanks with red lettering on a white background. Fabricate using 18 ga vitreous enameling steel (ASTM A424 - type II). Equip each with 6 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"**

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:

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"EXIT" "SALIDA"

Where shown on the Drawings, provide illuminated exit signs specified in Section 16500 - Lighting.

3.2 WELDING

- A. Welding Steel: Welding shall be performed in accordance with the "Structural Welding Code-Steel", AWS D1.1, and current revisions, except where the Gas Metal Arc Welding (GMAW) process is used, the short-circuited mode shall only be used for light gauge material (12 gauge and lighter). Welders shall be qualified by tests in accordance with AWS B3.0.

3.3 GALVANIZING

- A. Galvanizing: All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox," "Galvo-Weld," or equal.

3.4 PAINTING

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

**** END OF SECTION ****

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide rough carpentry and appurtenant Work, complete, in accordance with the CONTRACT DOCUMENTS.
- B. The Work shall include the following principal items:
 - 1. Wood framing, including plates, studding, joists, rafters, purlins, and similar framing elements.
 - 2. Wood blocking, furring, stripping, backing, and nailers, as indicated or otherwise required for securing other Work, except for such items which are indicated to be furnished by other trades.
 - 3. Plywood sheathing, board sheathing, sidings and starter boards.
 - 4. All rough hardware appurtenant to the Work of this Section.

1.2 RELATED DOCUMENTS

- 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 01300 Submittals
 - 2. Section 03100 Concrete Formwork
 - 3. Section 03300 Cast-in-Place Concrete
 - 4. Section 04232 Reinforced Concrete Block Masonry
 - 5. Section 05120 Structural Steel
 - 6. Section 05500 Miscellaneous Metals

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. The Work of this Section shall comply with the current edition of the California Building Code (CBC) as adopted by the City of San Diego.
- C. Federal Specifications:
 - 1. FF-B-561C Bolts, (Screws), Lab.

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2. FF-B-575C Bolts, Hexagon and Square
 3. FF-B-584E(1) Bolts, Finned Neck, Key Head; Machine Ribbed Neck, Square Neck, Tee Head
 4. FF-B-588D Bolt, Toggle: Expansion Sleeve, Screw
 5. FF-N-105B(3) Int. Amd. 4 Nails, Brads, Staples and Spikes, Wire, Cut and Wrought
 6. FF-N-836E Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat
 7. FF-S-111D(1) Screw, Wood
 8. U.S. Product Std. PS-1 Construction and Industrial Plywood
- D. Commercial Standards:
1. AITC 104 Typical Construction Details
 2. AITC 105 Timber Construction Manual, Recommended Practice for the Erection of Structural Timber Framing
 3. ASME/ANSI B18.2.1 Bolts, (Screw), Lag
 4. ASME/ANSI B18.18.1 Bolts, (Screw), Lag
 5. ASTM D 226 REVA Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 6. ASME/ANSI B18.9 Nails, Brads, Staples and Spikes; Wire, Cut and Wrought
 7. AWPA C1 AWPA Manual of Recommended Practice, Standard For Preservative Treatment by Pressure Process--All Timber Products
 8. ASTM F1667 Nails, Brads, Staples and Spikes; Wire, Cut and Wrought
 9. FPL Bulletin 1069 Effect of Pretreatment of Wood on the lignin Determination; Distribution of Methoxyls in Wood
 10. RIS Standard Specifications for Grades of California Redwood Lumber by the Redwood Inspection Service

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| 11. SPIB | Grading Rules for Southern Pine Lumber of the Southern Pine Inspection Bureau |
| 12 .WCLIB | Standard Grading and Dressing Rules No. 16 of the West Coast Lumber Inspection Bureau |
| 13. WWPA | Standard Grading Rules for Western Lumber, Western Wood Products Association |

1.4 SUBMITTALS

- A. The following shall be submitted to RESIDENT ENGINEER in accordance with Section 01300 - Submittals.
 - 1. Manufacturers' catalogs showing rough hardware conforming to or equivalent to hardware indicated.
 - 2. Certificates of compliance.
 - 3. Inspection report of independent inspection agency showing that the product complies with applicable AWPA treatment standards. The quality mark ALP-22" on each piece will be accepted in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

3.1 GENERAL

- A. Only lumber certified as complying with the indicated requirements shall be provided.
- B. Lumber shall be new, of current manufacture, and shall be the products of reputable mills specializing in producing such lumber.
- C. Lumber and plywood shall comply with SSPWC Subsection 204-1 and this Section.

3.2 UNTREATED LUMBER

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- A. Grading: Lumber shall be graded in accordance with the rules of one of the following associations: "Grading Rules for Southern Pine Lumber" of the Southern Pine Inspection Bureau; "Standard Grading and Dressing Rules No. 16" of the West Coast Lumber Inspection Bureau (WCLIB); or "Grading Rules for Western Lumber" published by Western Wood Products Association.
- B. Grade Marking: Each piece of lumber shall bear the official grade mark of one of the above-mentioned grading rules. The Association standards for grading and grade marking of the lumber shall be acceptable to RESIDENT ENGINEER.
- C. Size Dressing: All lumber, except as otherwise indicated, shall be dressed to size in accordance with the standards of the association under which the lumber is graded. All lumber shall be S4S unless otherwise indicated.
- D. Drying: All lumber incorporated in the Work, except where otherwise indicated on the Drawings, shall be air or kiln dried to a moisture content of not more than 12 percent, and not less than 7 percent.

3.3 REDWOOD

- A. Redwood shall conform to applicable requirements of the "Standard Specifications for Grades of California Redwood Lumber" of the Redwood Inspection Service (RIS). Redwood lumber used for foundation plates or in contact with concrete shall be Foundation Grade, S4S, Redwood.

3.4 TREATED LUMBER

- A. SSPWC Compliance: Lumber shall be treated with preservatives in compliance with SSPWC Subsection 204-2.1 and this Section.
- B. Marking: Each piece of treated lumber shall bear the approval mark of an approved testing agency.
- C. Kiln Drying: Kiln-dried lumber shall be treated with a water-borne preservative and shall have a maximum moisture content of 15 percent after treatment.
- D. Pressure-Treated Lumber: All wood nailing blocks, sills, and plates resting on or embedded in concrete or masonry within 18 inches of grade shall be pressure-treated in accordance with AWPAC1. Preservative shall conform to UBC Standard 25-12] Creosote shall not be used.
- E. Preservative: Two thorough coats of preservative, Zehrunge "Zerpel"; Sherwin Williams, "Kemwood Penta," or approved equal, shall be applied at least 2 hours before installation, to all surfaces which come in contact with, or are set close to concrete and plaster, except lumber specified to be pressure-treated. Tank dipping or pressure-treating may be used.

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- F. Cuts: Wherever necessary to cut, notch, dap, drill, or frame treated lumber, newly cut or bored surfaces shall be treated with two heavy coats of the same preservative used in the original treatment. The minimum preservative penetration depth shall be 1/4 inch.
- G. Fire-Retardant Treated Lumber: Where required, fire-retardant treatment for lumber shall conform to the requirements of the governing building code.

3.5 PLYWOOD

- A. Plywood: Plywood shall conform to the requirements of U.S. Product Standard PS-1 and as indicated herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type, and grade in compliance with the applicable commercial standard. Except as otherwise indicated, plywood shall be Douglas Fir, Exterior. Plywood for other specific applications shall be as follows:
 - 1. Plywood for use in concrete forms shall conform to the requirements of Section 03100 - Concrete Formwork.
 - 2. Plywood for back-up boards behind telephone equipment, electrical equipment, or communication equipment shall be Douglas Fir, A-C IN grade for interior locations and A-C-EXT for exterior locations.
 - 3. Plywood tool boards and protective wall paneling shall be Douglas Fir N-D-IN grade.
- B. Used Lumber: For concealed, non-load-bearing applications, used form lumber (excepting plywood) which is undamaged and complies with requirements herein may be reused if permitted by the RESIDENT ENGINEER.

3.6 ROUGH HARDWARE

- A. General: The term "rough hardware" shall include nails, screws, lag screws, bolts, nuts, washers, plates, metal fasteners, and framing anchors; anchor bolts which are to be embedded into concrete, concrete masonry, or brick masonry; and similar items employed in erection and construction of the rough carpentry Work. Rough hardware shall be of standard manufacture, approved by a recognized agency for the intended applications and shall be provided with laboratory test results on capabilities when requested by the RESIDENT ENGINEER. All hardware items shall be steel unless otherwise indicated. Specially fabricated rough hardware shall be provided in accordance with Section 05120 -Structural Steel and Section 05500 - Miscellaneous Metals and shall be hot-dip galvanized after fabrication.

SECTION 06100 - ROUGH CARPENTRY

- B. Anchors and Fasteners: Anchors and fasteners for securing wood items, unless otherwise indicated, shall be as follows:
1. Bolts, nuts, and studs shall conform to the requirements of ASME/ANSI B18.9 and Federal Specifications FF-N-836E(3), FF-S-1362, and FF-B-575C, as applicable and as specified in Section 05500 - Miscellaneous Metals.
 2. Nails and staples shall conform to ASTM F1667, and shall be the type and size best suited for the intended application. Nails shall be galvanized steel, aluminum, or stainless steel, as appropriate, where exposed to weather. Nails used for fastening plywood to nailers on steel beams shall be of wire gage noted for common nails, but of 2 length. Nails used for exterior (exposed to view) plywood siding, siding, or trim shall be stainless steel.
 3. Wood screws shall conform to the requirements of Federal Specification FF-S-111D(1) for the style and material as shown or best suited for the purpose. Wood screws shall be galvanized where exposed to view or to weather.
 4. Lag screws or lag bolts shall conform to the requirements of Federal Specification FF-B-561D for the type and grade best suited for the purpose. Lag screws or lag bolts shall be galvanized where exposed to view or weather.
 5. Toggle bolts shall conform to the requirements of Federal Specification FF-B-588D for the type and grade best suited for the purpose.
 6. Expansion shields shall be in accordance with Section 05500 - Miscellaneous Metals.
 7. Power-driven pins shall be in accordance with Section 05500 - Miscellaneous Metals.
- C. Metal Framing Devices: Metal framing devices shall be specially designed joist hangers, header hangers, framing anchors, post anchors, and structural framing connectors fabricated from steel and hot-dip galvanized after fabrication. They shall be designed to conform to code requirements. Documentation of load tests by an independent testing laboratory shall be submitted if requested by the RESIDENT ENGINEER. The framing devices shall be as manufactured by Silver Metal Products, Inc.; Easy Ardes Rib, Simpson Co.; Heckmann Building Products; Harlen Metal Products, Inc.; or approved equal. The framing devices shall be equal or superior to those shown as per design, friction, and loading. The framing device shall be provided complete

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with the proper sized nails, bolts, lag bolts, or other required fasteners called for in the design calculations for the framing devices.

- D. Plyclips: Plyclips shall be extruded aluminum clips, manufactured from 6063-T6 aluminum alloy, and designed for intended use. Size shall be as required for plywood or shall be as indicated.

3.7 MISCELLANEOUS PRODUCTS

- A. Building Paper: Building paper or felt shall be non-perforated, asphalt-saturated organic felt conforming to ASTM D 226, 15 pounds per 100 square feet.
- B. Termite Shields: Termite shields shall be not less than 26-gage, zinc-coated steel or 30-gage, terne steel coated with 40 pounds of coating material per 100 square feet.

PART 3 - EXECUTION

3.1 GENERAL

- A. Preliminaries: Rough carpentry shall be as indicated and as necessary for complete Work. Verify drawing dimensions with actual field conditions, inspect related Work and adjacent surfaces, and report to the RESIDENT ENGINEER all conditions which could prevent proper execution of this Work.
- B. Work Coordination and Performance: Coordinate all the Work and cooperate with the subcontractors and the trades doing related Work. All Work of construction shall be carefully planned and laid out. All Work shall be performed under the direction of a capable, experienced supervisor.
- C. Rough Hardware: All rough hardware not otherwise indicated and which is necessary for the satisfactory execution of framing, including nails, spikes, dowels, fasteners, and similar incidentals shall be provided. Rough hardware shall be coordinated, furnished, installed, and embedded as indicated and as required for a complete Work.
- D. Framing: Framing members and assemblies shall be closely fitted, accurately set, and rigidly secured to required lines, levels, and arrangements. Framing shall be accurately and neatly cut and shall be securely nailed, spiked, or otherwise fastened in place in a workmanlike manner. Timber connectors and installation thereof shall conform to applicable requirements of AITC 104 and AITC 105.

3.2 FASTENERS AND FRAMING DEVICES

- A. Nailing: Where nail spacing is not otherwise regulated by the Building Code, nails shall not be driven closer together than 2 their length unless driven in

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drilled holes, nor driven closer to the edge of a member than 1/4 of their length. When necessary to prevent splitting, holes shall be drilled slightly smaller than nail diameters. The nails shall penetrate the second or farther member not less than 2 the nail length. Common nails shall be used unless otherwise indicated.

- B. Bolts and Nuts: Malleable or cut-steel washers shall be provided under bolt heads and nuts except where bearing on steel plates or other steel attachments or where flat-head countersunk bolts indicated. Bolt holes shall be drilled 1/32 inch to 1/16 inch larger diameter than the bolts they are to accommodate, and shall be bored true-to-line. Members shall be clamped together and bolts shall be driven in place and nuts drawn up tightly. Bolts shall be drawn tight again immediately prior to enclosing with finish or, if left exposed, upon completion of other Work. Holes at anchor bolts embedded in concrete may be 1/16 inch larger than bolt diameter.
- C. Screws: Lag and wood screws shall be screwed, not driven, into place. Holes to receive lag screws shall be bored first of the same diameter and depth as shank, then continued to depth equal to length of screw with diameter equal to the base of the screw thread. Screws shall penetrate into the farther member a distance equal to a least seven times the diameter of the screw shank. Washers shall be installed under each lag screw head bearing on wood.
- D. Metal Framing Devices: Metal framing devices shall be provided where indicated. Nails for the framing devices shall be as furnished or recommended by the manufacturer of the anchor device. All nails shall be driven to their full depth at all holes in anchors. Bolt and lag fasteners shall be drawn tight.

3.3 FRAMING

- A. Strength Considerations: Structural wood framing members shall not be spliced between bearing points or supports. Approval shall be secured from the RESIDENT ENGINEER before cutting of any wood members that may weaken structure. Due care shall be exercised in placing framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits, or ducts. Bearing surfaces on which wood structural members are to rest shall be finished to give full, true, and even support. Wedges or shims shall not be used to correct faulty Work. Wood members which have been split or otherwise damaged to such an extent as to impair their strength shall be removed and replaced at no additional cost to the OWNER.
- B. Cutting and Notching: Only skilled workmen shall be used for all cutting and framing of wood members required to accommodate structural members, routing of piping, conduit, ducts, and the installation of mechanical, electrical, or other apparatus or equipment. Members shall not be cut, notched, nor bored more than 1/4 of their depth without adequate and approved reinforcing.

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- C. Plate/Sill Material: Plates and sills shall be foundation grade redwood or Douglas fir, pressure-treated with a water-borne preservative meeting the requirements of AWPA Standard P5. Only pressure processes described in AWPA C1 shall be used.
- D. Plate and Sill Installation: Bottom plates and sill plates which are secured to concrete shall be located as indicated. The anchor bolts shall be located as shown or as required by Referenced Standard if not indicated. The plates and sills shall be leveled with shims. Washers shall be placed and nuts shall be tightened to level bearing, after which the space (2-inch minimum) between the sill and concrete shall be dry-packed with concrete as specified in Section 03300 - Cast-in-Place Concrete.
- E. Blocking and Backing: All blocking and backing in walls and ceilings shall be nominal 2-inch thick material of a depth as needed and shall be accurately located around light fixtures, ceiling registers, grilles, and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood blocking (backing) to receive sheathing, siding, metal lath, and gypsum board shall be provided wherever necessary for securing the facing materials.
- F. Rafters and Joists: Rafters and joists shall be placed crown up and supported firmly on the framing below. Care shall be used in selection and placing of members. Positive and secure attachment shall be provided. The CONTRACTOR shall provide double joists and double headers to receive trimmers at openings which cut or interrupt normal rafter spacing.
- G. Roofs: Roofs shall be erected level or shall be sloped as indicated or approved.
- H. Plywood Sheathing: Plywood sheathing shall be installed with face grain across supports and end joints shall be over joists and shall be staggered. Blocking shall be provided at all unsupported edges.
- I. Fire Stops: Fire stops shall be not less than 2-inch nominal thickness and of the same width as the studs. Strips of full-thickness fiber glass or rock wool shall be installed around pipes, ducts, conduits, and other penetrations through fire stops.
- J. Sleepers: All sleepers for mechanical equipment and curb openings shall be provided and coordinated with appropriate trades for locations and sizes. Sleepers shall be ripped to conform to roof slope if necessary.
- K. Sand Blasting: Members required to be sandblasted shall be lightly sand blasted. Field sandblasting shall conform to requirements of the governing authorities.

***** END OF SECTION *****

SECTION 07100 – WATERPROOFING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide waterproofing and moistureproofing of concrete surfaces.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 03300 Cast-In-Place Concrete
 - 3. Section 07920 Sealants and Caulking

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current edition of the Uniform Building Code (UBC) as adopted by the City of San Diego.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 7. ASTM D 41 Specification for Asphalt Primer Used in Roofing and Waterproofing
 - 8. ASTM D 226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - 9. 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.

SECTION 07100 – WATERPROOFING

- 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 2-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:

SECTION 07100 – WATERPROOFING

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. Kopper's Bitumastic 300-M
 - b. Porter Maxi Build II
2. Moistureproofing Coating:
 - a. Kopper's Bitumastic 50
 - b. Porter Tarmastic 100
3. Waterproofing Membrane:
 - a. W.R. Grace and Company's "Bituthene"
 - b. Protecto Wrap Co.'s "Jiffy Seal"
4. Waterproofing Protective Board:
 - a. Celotex Insulation Board
5. Below-Grade Waterproofing:
 - a. Waterproofing System: EMW-1 Waterproofing System by Flintkote Company
Bird & Sons
 - b. Expansion Joint Sheets:
 - (1) "Flash-bend" by Flintkote Co.
 - (2) "Bituthene" by W.R. Grace and Co.

SECTION 07100 – WATERPROOFING

- c. Emulsion: Liquid Boot, LBI Technologies, Inc.
- d. Geotextiles: Minardi 300 HV Protection Course

PART 3 – EXECUTION

3.1 GENERAL

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

3.2 WATERPROOFING COATING

- A. Location: Waterproofing coating shall be applied to the water side of walls and bottoms of channels or tanks which are common with rooms, tunnels or galleries to be occupied by equipment, piping, conduit, or personnel.
- B. Surface Preparation: New concrete to be waterproofed shall have aged at least 28 days and allowed to dry to a moisture content recommended by the coating manufacturer. Concrete surfaces shall be sandblasted. Voids and cracks shall be repaired.
- C. Applications: Prime coat shall be thinned and applied at the rate of approximately 200 to 300 square feet per gallon depending on surface condition. Finish coats shall be applied at the rate of 100 square feet per gallon. Final coat shall be black. Total dry film thickness shall be minimum 20 mils. Drying time between coats shall be as recommended by the coating manufacturer.

3.3 MOISTUREPROOFING COATING

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

3.4 WATERPROOFING MEMBRANE

SECTION 07100 – WATERPROOFING

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

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

3.5 MOISTUREPROOFING UNDERLAY

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

3.6 BELOW-GRADE WATERPROOFING

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

**** END OF SECTION ****

SECTION 07160 – CRYSTALLINE WATERPROOFING

PART 1 – GENERAL

1.1 WORK OF THIS SECTION INCLUDES

- A. The CONTRACTOR shall provide crystalline waterproofing system for the interior of the reservoir in accordance and shall include all appurtenant Work, complete, in accordance with the CONTRACT DOCUMENTS.
- B. This specification covers furnishing of all labor, materials, services and equipment necessary for the supply and installation of cementitious crystalline waterproofing to concrete substrates, above-grade or below-grade, on either dry or wet side of substrates, as indicated on drawings and as specified herein.

1.1 RELATED WORK

- 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.
 - 4. Section 01300 Submittals
 - 5. Section 03280 Joints in Site Wrok Concrete
 - 6. Section 03300 Cast-in-Place Concrete

1.2 REFERENCES

- C. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. USACE CRD C48-73 Permeability of Concrete
 - 2. DIN 1048 Impereability to Water
 - 3. ASTM C 267 Chemical Resistance of Mortars, Grouts amd Monolithiic Surfacing
 - 4. ASTM C 672 Standard Test Method for Scaling Resistance to Concrete Su
 - 5. rfaces Exposed to De-icing Chemicals

SECTION 07160 – CRYSTALLINE WATERPROOFING

6. NSF/ANSI 61-2013 Drinking Water System Components – Health Effects

1.3 SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals:
 1. Product Data
 - a. Preparation instructions and recommendations
 - b. Storage and handling requirements and recommendations
 - c. Installation methods
 2. Test data from independent testing laboratories.
 3. Manufacturer's certification or manufacturer's representative that all materials used for the installation comply with these specifications.
 4. Installer's certification from manufacturer that he/she is a qualified applicator.
 5. Manufacturer's or manufacturer's representative confirming that the surface to which waterproofing material is to be applied are in a suitable condition for application.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be ISO 9001 registered, and shall have no less than 10 years experience in manufacturing the cementitious crystalline waterproofing materials for the required work. Manufacturers that cannot provide the performance test data specified herein will not be considered for the project.
- B. Applicator: Waterproofing applicator shall be experienced in the installation of cementitious crystalline waterproofing materials as demonstrated by previous successful installations, and shall be approved by the manufacturer in writing.
- C. Pre-Installation Conference: Prior to installation of waterproofing, conduct meeting with waterproofing applicator, installers of work adjacent to or which penetrates waterproofing, RESIDENT ENGINEER and waterproofing manufacturer's representative to verify and review the following:

SECTION 07160 – CRYSTALLINE WATERPROOFING

1. Project requirements for waterproofing as set out in CONTRACT DOCUMENTS.
 2. Manufacturer's product data including application instructions.
 3. Substrate conditions, and procedures for substrate preparation and waterproofing installation.
- D. Technical Consultation: The waterproofing manufacturer's representative shall provide technical consultation on waterproofing application.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Deliver packaged waterproofing materials to project site in original undamaged containers, with manufacturer's labels and seals intact.
- 1.6 SITE CONDITIONS
- A. Compliance: Comply with manufacturer's product data regarding condition of substrate to receive waterproofing, weather conditions before and during installation, and protection of the installed waterproofing system.
- 1.7 WARRANTY
- A. Manufacturer's Warranty: Manufacturer shall provide standard product warranty executed by authorized company official. Term of warranty shall be [specify term] years from Date of Substantial Completion.
- B. Applicator's Warranty: Applicator shall warrant the waterproofing installation against defects caused by faulty workmanship or materials for a period of [specify term] years from Date of Substantial Completion. The warranty will cover the surfaces treated and will bind the applicator to repair, at his expense, any and all leaks through the treated surfaces which are not due to structural weaknesses or other causes beyond applicator's control such as fire, earthquake, and hurricane.

The warranty shall read as follows: The coating manufacturer warrants that, upon completion of the work, surfaces treated with cementitious crystalline waterproofing will be and will remain free from water leakage resulting from defective workmanship or materials for a period of 10-years from Date of Substantial Completion. In the event that water leakage occurs within the warranty period from such causes, the applicator shall, at his sole expense, repair, replace or otherwise correct such defective workmanship or materials. Applicator shall not be liable for consequential damages and applicator's liability shall be limited to repair, replacement or correcting of defective workmanship or materials. Applicator shall have no responsibility with respect to water leakage or other defects caused by structural failure or movement of the structure, or any other causes beyond Applicator's control.

SECTION 07160 – CRYSTALLINE WATERPROOFING

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Xypex Chemical Corporation, 13731 Mayfield place, Richmond , BC, Canada V6V 2G9. Telephone: 800-961-4477 or 604-273-5265. Fax 604-270-0451. www.xypex.com.
- B. Or approved equal.

2.2 MIXES

- A. General: Mix waterproofing material by volume with clean water which is free from salt and deleterious materials. Mix waterproofing material in quantities that can be applied within 20 to 30 minutes from time of mixing. As mixture thickens, stir frequently, but do not add additional water. Do not mix bonding agents or admixtures with crystalline waterproofing materials.
- B. Brush Application Mix: Measure dry powder and place in mixing container. Measure water and mix into the dry powder with a paddle on a slow speed electric drill (250 RPM) or other type mixer which is acceptable to manufacturer. Mixing proportions shall be as follows:

Coverage	Proportions (by Volume)
1.5 lb./sq. yd. (0.8 kg/m ²)	5 powder to 2 water
2.0 lb./sq. yd. (1.0 kg/m ²)	3 powder to 1 water

- C. Spray Application Mix: Mixing shall be same as specified for brush application except that mixture shall be thinner. Use following proportions as a guide only. Adjust proportions to match type of spray equipment and pressures used. Mixing proportions shall be as follows:

Coverage	Proportions (by Volume)
1.5 lb./sq. yd. (0.8 kg/m ²)	5 powder to 3 water

- D. Dry-Pac Mix: Using a trowel, mix 1 part clean water with 6 parts Xypex Concentrate powder for 10 to 15 seconds. It is acceptable that lumps may be present in mixture. Mix only as much as can be applied in 15 minutes.

2.3 REQUIREMENTS

- A. The crystalline coating shall meet the following requirements:

SECTION 07160 – CRYSTALLINE WATERPROOFING

1. Treated concrete (2000 psi 28 day compressive strength) shall be pressure tested to 175 psi water with no measureable leakage using USACE CRD C48-73.
2. Treated concrete samples pressure tested to 100 psi for 24 hours shall not show water penetration past 4 mm per DIN 1048.
- 3.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Site Visit: Prior to waterproofing installation, arrange visit to project site with water-proofing manufacturer's representative. Representative shall inspect and certify that concrete surfaces are in acceptable condition to receive waterproofing treatment.
- B. Verification of Substrates: Verify that concrete surfaces are sound and clean, and that form release agents and materials used to cure the concrete are compatible with waterproofing treatment.
- C. Examination for Defects: Examine surfaces to be waterproofed for form tie holes and structural defects such as honeycombing, rock pockets, faulty construction joints and cracks. Such defects to be repaired in accordance to manufacturer's product data and Subsection 3.02 below.

3.2 PREPARATION

- A. Concrete Finish: Concrete surfaces to receive waterproofing treatment shall have an open capillary system to provide tooth and suction, and shall be free from scale, excess form oil, laitance, curing compounds and foreign matter. Horizontal surfaces shall have a rough wood float or broom finish. Where a smooth trowel finish is required on horizontal surface, crystalline waterproofing material shall be applied by dry shake method at time of concrete finishing in accordance with manufacturer's product data.
- B. Surface Preparation: Smooth surfaces (e.g. where steel forms are used) or surfaces covered with excess form oil or other contaminants shall be washed, lightly sand-blasted, water-blasted, or acid etched with muriatic acid as necessary to provide a clean absorbent surface. Surfaces to be acid-etched shall be saturated with water prior to application of acid.
- C. Repair of Defects: Surface defects shall be repaired in accordance with manufacturer's instructions as follows:

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1. Form Tie Holes, Construction Joints, Cracks: Chip out defective areas in a “U” shaped slot one inch (25 mm) wide and a minimum of one inch (25 mm) deep. Clean slot of debris and dust. Soak area with water and remove excess surface water. Apply a slurry coat of Xypex Concentrate at the rate of 1.5 lb./sq. yd. (0.8 kg/m²) to the slot. Allow slurry to reach an initial set, then fill cavity with Dry-Pac.

Compress tightly into cavity using pneumatic packer or block and hammer.

2. Rock Pockets, Honeycombing or Other Defective Concrete: Rout out defective areas to sound concrete. Remove loose materials and saturate with water. Remove excess surface water and apply a slurry coat of Xypex Concentrate to area. After slurry has set, but while still “green”, fill cavity to surface level with non-shrink grout.

- D. Wetting Concrete: Prior to application of waterproofing treatment, thoroughly saturate concrete surfaces with clean water as required to ensure migration of crystalline chemicals into voids and capillary tracts of the concrete. Remove free surface water before application.

3.3 APPLICATION

- A. Construction Joints: Apply Xypex Concentrate in slurry form at a rate of 2.0 lb./sq. yd. (1.08 kg/m²) to joint surfaces between concrete pours. Moisten surfaces prior to slurry application. Where joint surfaces are not accessible prior to pouring new concrete, consult manufacturer for application procedure.
- B. Sealing Strips and Coves: Prepare concrete surfaces that will come into contact with sealing strips and coves by applying one coat of Xypex Concentrate in slurry form at a rate of 1.5 lb./sq. yd. (0.8 kg/m²). Then apply Xypex Concentrate in Dry-Pac form (sealing strip) or Xypex Modified in mortar consistency (cove) after slurry coat has reached an initial set but is still “green”.
1. Sealing Strips: Where indicated on drawings, fill preformed grooves, one inch (25 mm) wide and minimum of 1.5 inch (37 mm) deep, located at construction joints with Xypex Concentrate in Dry-Pac form. Compact Dry-Pac tightly into groove using a pneumatic packer or hammer and block.

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2. Coves: Where indicated on drawings, trowel apply and pack Xypex Modified mortar into a cove shape.
- C. Surface Application: After repairs, surface preparation, treatment of construction joints and sealing strip placement have been completed in accordance with manufacturer's product data and as specified herein, apply Xypex treatment uniformly to concrete surfaces with semi-stiff bristle brush or broom, or suitable spray equipment. Application rates and locations shall be as indicated in the drawings and in accordance with manufacturer's product data. When brushing, work slurry well into surface of the concrete, filling surface pores and hairline cracks. When spraying, hold nozzle close enough to ensure that slurry is forced into pores and hairline cracks.
1. First Coat (of one or two coat application): Apply Xypex Concentrate slurry coat to locations indicated on drawings in accordance with manufacturer's product data.
 2. Second Coat (of two coat application): Where indicated on drawings or as required by manufacturer's product data, apply Xypex Modified slurry coat while first coat of Xypex Concentrate is still "green" but after it has reached an initial set. Use light prewatering between coats when rapid drying conditions exist.
- D. Sandwich (Topping) Application: When treated structural slabs are to receive a concrete or other topping, place the topping while waterproofing material is still "green" but has reached an initial set. Lightly prewater when rapid drying conditions exist.

3.4 CURING

- A. General: Begin curing as soon as crystalline coating has hardened sufficiently so as not to be damaged by a fine spray. Cure Xypex treatment with a mist fog spray of clean water three times a day for 2 to 3 days, or cover treated surfaces with damp burlap for the prescribed period. In warm climates, more than three sprayings per day may be necessary to prevent excessive drying of coating.
- B. Air Circulation: Do not lay plastic sheeting directly on the waterproofing coating as air contact is required for proper curing. If poor circulation exists in treated areas, it may be necessary to provide fans or blown air to aid in curing of waterproofing treatment.

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- C. Holding Structures: For concrete holding structures such as swimming pools, reservoirs, water treatment tanks and wet wells, cure crystalline treatment for three days and then allow treatment to set (air cure) for 12 days before filling structure with liquid. For structures holding hot or corrosive liquids, cure waterproofing treatment for three days and allow to set for 18 days before filling.
- D. Protection: During the curing period, protect treated surfaces from damage by wind, sun, rain and temperatures below 36°F (2°C). If plastic sheeting is used for protection, it must be raised off of waterproofing coating to allow sufficient air circulation.
- E. Curing Agent: If moist curing is not possible, use a chemical curing agent that is specifically designed for or compatible with the approved crystalline waterproofing treatment. Curing agent shall have at least two years of successful field use and shall be approved by waterproofing manufacturer in writing.

3.5 INTERFACE WITH OTHER MATERIALS

- A. Backfilling: Do not backfill for 36 hours after application. If backfill takes place within seven days after application, then backfill material shall be moist so as not to draw moisture from waterproof coating.
- B. Paint, Epoxy or Similar Coatings: Do not apply paint or other coatings until waterproofing treatment has cured and set for a minimum of 21 days. Before applying paint or coating, neutralize treated surface by dampening with water and then washing waterproofed surface with 15% muriatic acid, diluted in a ratio of one part acid to four parts water by volume. Flush acid off treated concrete surfaces.
- C. Grout, Cement Parge Coat, Plaster or Stucco: Because the waterproof coating forms a relatively smooth surface and the resulting crystalline formation fills the concrete pores thereby reducing suction characteristics of the concrete, it may be necessary to use a suitable bonding agent for proper bonding of cementitious systems. Trial applications are recommended to ensure that adhesion requirements are satisfied.
- D. Responsibility to Ensure Compatibility: Xypex Chemical Corporation makes no representations or warranties regarding compatibility of Xypex treatment with coatings, plasters, stuccos, tiles or other surface-applied materials. It shall be the responsibility of the installer of the surface-applied material that is to be applied over the Xypex waterproofing treatment, to take whatever measures

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are necessary, including testing, to ensure acceptance by or adhesion to the waterproofing treatment.

3.6 FIELD QUALITY CONTROL

- A. Observation: Do not conceal installed waterproofing system before it has been observed by Architect/Engineer, waterproofing manufacturer's representative and other designated entities.
- B. Flood Testing:
 - 1. Perform flood test on completed waterproofing installation before placement of other construction.
 - 2. Plug or dam drains and fill area with water to a depth of two inches (50 mm) or to within 0.5 inch (12.5 mm) of top of waterproofing treatment.
 - 3. Let water stand for 24 hours.
 - 4. If leaks are discovered, make repairs and repeat test until no leaks are observed.

3.7 CLEANING AND PROTECTION

- A. Cleaning: Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures.
- B. Protection: Take measures to protect completed crystalline coating from damage after application. Do not permit traffic on unprotected coating.

**** END OF SECTION ****

SECTION 07322 - CONCRETE ROOF TILES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Light Weight Concrete roof tiles.
 - 2. Tile accessories.
 - 3. Felt underlayment.
 - 4. Self-adhering sheet underlayment.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 01300 Submittals
 - 2. Section 05120 Structural Steel
 - 3. Section 07600 Flashing and Sheet Metal
 - 4. Section 07720 Roof Accessories
 - 5. Section 07721 Rooftop Fall Protection
 - 6. Section 07800 Skylights
 - 7. Section 07920 Sealants and Caulking

1.3 RELATED DOCUMENTS

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

1.4 REFERENCES

- A. UL 790: Standard Test Methods for Fire Tests of Roof Coverings

1.5 DEFINITIONS

- A. ASTM: American Society for Testing and Materials

SECTION 07322 - CONCRETE ROOF TILES

- B. NRCA: National Roofing Contractors Association
- C. WSRCA: Western States Roofing Contractor's Association
- D. FRSA: Florida Roofing, Sheet Metal, & Air Conditioning Contractors Association, Inc.
- E. NTRMA: National Tile Roofing Manufacturers Association
- F. RTI: Research Triangle Institute

1.6 SUBMITTALS

- A. The Contractor shall provide the following submittals:
 - 1. Product Data: CONTRACTOR shall submit manufacturer's detailed technical product data and installation instructions for each principal component of product. Submittal shall include a complete description of tile properties, configurations, special shapes, and securement methods.
 - 2. Samples: Two tile units shall be submitted representative of each color in the range or blend selected. Samples shall be full size, and representative of the color, surface finish and texture or the finished tile installation.
 - 3. CONTRACTOR shall submit manufacturer's written certification and acceptance of the installer and his qualifications, along with documentation of the installer's experience background containing names, addresses, and sizes of projects with dates of completion.
 - 4. Warranty: CONTRACTOR shall submit for review, a copy of the warranty that will be provided upon completion of the WORK, for the concrete tile roof system.

1.7 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide concrete tiles and related roofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; UL 790 or ASTM E 108 for application and roof slopes indicated.

1.8 WARRANTY

SECTION 07322 - CONCRETE ROOF TILES

- A. The warranty period shall extend for 60 months following the date of acceptance of the roofing tile installation.
- B. Warranty: A special project warranty shall be provided, signed by the Contractor, agreeing to replace, repair, or restore as directed by the Owner, defective materials and workmanship of roofing tile WORK discovered during the warranty period. "Defective" shall be defined to include, but not by way of limitation, excessive discoloration, unusual deterioration or fading or other evidences of aging of materials or finishes; leakage; the need for excessive maintenance, and similar unusual, unexpected and unsatisfactory conditions.
- C. Warranty shall cover damage to building and contents resulting from failure to resist penetration of water.
- D. For warranty repair work, the CONTRACTOR shall be responsible for all aspects of removing and replacing failed materials as well as related materials and assemblies which may be affected by warranty repair work or concrete tile roofing. Such responsibility shall include, but not necessarily be limited to, responsibility for protection, removal, and replacement of related or connected items and other installed items such that the completed repair is no less than equal to the original WORK.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Roofing tiles and accessory materials shall be delivered to the site in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken
- B. Storage: All components and assemblies shall be carefully stored in an area that is protected from deleterious elements, in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to components and assemblies or marring of finish surfaces

PART 2 - PRODUCTS

2.1 CONCRETE TILE

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Bartil;
 - 2. Dectile
 - 3. Eagle Roofing Products
 - 4. Entegra Roof Tile Corp.

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5. Hanson Roof Tile, Inc.
 6. MonierLifetile
 7. Staco Roof Tile
 8. Westile Roofing Products
- B. Concrete Tile: ASTM C 1492, molded- or extruded-concrete roof tile units of shape and configuration indicated, with integral color, and free of surface imperfections. Provide with fastening holes predrilled at factory when manufactured.
1. Shape: High-Profile
 2. Color: Selected from manufacturer full line
 3. Size: Selected from manufacturer full line

2.2 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Cold-Applied Adhesive: Manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with underlayments.
- C. Mortar: ASTM C 270, Type M, natural color for concealed-from-view mortar.
1. Mortar Pigment: ASTM C 979. Produce mortar matching the color of tile selected for exposed-to-view mortar.
- D. Eave Closure: Manufacturer's standard EPDM (ethylene propylene diene monomer) stainless-steel zinc-tin alloy-coated, stainless-steel eave closure formed to shape of tile.
- E. Ridge Closure: Manufacturer's standard EPDM (ethylene propylene diene monomer) ridge closure formed to shape of tile.

2.3 FASTENERS

- A. Roofing Nails: ASTM F 1667, hot-dip galvanized steel, 0.1055-inch- diameter shank, sharp-pointed, conventional roofing nails with barbed shanks; minimum 3/8-inch- diameter head; and of sufficient length to penetrate 3/4 inch into solid wood decking.
- B. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

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- C. Wire Ties: Stainless steel, 0.083-inch minimum diameter.
- D. Hook Nails: One-piece wind lock and tile fastener system, minimum 0.09-inch-diameter galvanized steel wire, for direct deck nailing.
- E. Tile Locks: Stainless-steel, 0.1-inch- diameter wire device designed to secure butt edges of cover tiles.
- F. Storm Clips: Stainless-steel strap-type, 0.04-by-1/2-inch L-shaped retainer clips designed to secure side edges of tiles. Provide with two fastener holes in base flange.

2.4 UNDERLAYMENT MATERIALS

- A. Roll Roofing Underlayment: ASTM D 249, Type I, asphalt-saturated and -coated organic felt, mineral-granule surfaced.

2.5 SHEET METAL FLASHING AND TRIM

- A. Sheet Metal Flashing and Trim: Comply with requirements in Section 07620 "Sheet Metal Flashing and Trim."

- 1. Sheet Metal: Metallic-Coated steel sheet.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. General: Install underlayments according to tile manufacturer's written recommendations and recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Single-Layer Roof Felt Underlayment: Install perpendicular to roof slope in parallel courses. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with felt underlayment nails.
 - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides not less than 3 inches over self-adhering sheet underlayment in direction to shed water. Lap ends not less than 6 inches over self-adhering sheet underlayment.

3.2 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07620 "Sheet Metal Flashing and Trim."

SECTION 07322 - CONCRETE ROOF TILES

1. Install metal flashings according to tile manufacturer's written recommendations and recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

3.3 CONCRETE TILE INSTALLATION

- A. General: Install roof tiles according to manufacturer's written instructions and recommendations in RTI/WSRCA's "Concrete and Clay Roof Tile Design Criteria Installation Manual for Moderate Climate Regions," and to NRCA's "The NRCA Roofing and Waterproofing Manual."

1. Maintain uniform exposure and coursing of tiles throughout roof.
2. Extend tiles 2 inches over eave fasciae.
3. Nail Fastening: Drive nails to clear the tile so the tile hangs from the nail and is not drawn up.
 - a. Install wire through nail holes of cut tiles that cannot be nailed directly to roof deck, and fasten to nails driven into deck.
4. Mortar Setting: Install tile according to FRSA/NTRMA's "Concrete and Clay Roof Tile Installation Manual."
5. Install storm clips to capture edges of longitudinal sides of tiles and securely fasten to roof deck.
6. Install tile locks to support and lock overlying tile butts to underlying tiles.
7. Cut and fit tiles neatly around roof vents, pipes, ventilators, and other projections through roof. Fill voids with mortar.
8. Install tiles with color blend approved by RESIDENT ENGINEER.

***** END OF SECTION*****

SECTION 07600 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets and counterflashing.
2. Formed roof drainage sheet metal fabrications.
3. Formed wall sheet metal fabrications.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 05120 Structural Steel
3. Section 07322 Concrete Roof Tiles
4. Section 07720 Roof Accessories
5. Section 07721 Rooftop Fall Protection
6. Section 07800 Skylights
7. Section 07920 Sealants and Caulking

1.3 RELATED DOCUMENTS

A. Except as otherwise indicated in this Section, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 DEFINITIONS

- A. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association
- B. CDA: Copper Development Association

1.5 SUBMITTALS

- A. Submit in accordance Section 01300 - Submittals.

SECTION 07600 - FLASHING AND SHEET METAL

- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.
- D. Samples: For each exposed product and for each finish specified.
- E. Maintenance data.
- F. Warranty: Special warranty.

1.6 QUALITY ASSURANCE

- A. Sheet Metal flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- B. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

SECTION 07600 - FLASHING AND SHEET METAL

2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
3. Surface: Mill phosphatized for field painting.
4. Color: As selected by RESIDENT ENGINEER from manufacturer's full range.

2.2 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
- D. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

SECTION 07600 - FLASHING AND SHEET METAL

- c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 - 4. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
- 1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
 - 2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 REGLETS

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Material: Stainless steel, 0.019 inch thick.

SECTION 07600 - FLASHING AND SHEET METAL

2. Finish: Mill

2.5 FABRICATION- GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
1. Obtain field measurements for accurate fit before shop fabrication.
 2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

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1. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen and wire ball downspout strainer.
- B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 1. Hanger Style: as shown on the drawings and as recommended by SMACNA.
 2. Fabricate from the following materials:
 - a. Galvanized Steel: 0.022 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot- long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high, end dams where flashing is discontinuous. Fabricate from the following materials:
 1. Stainless Steel: 0.016 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
 1. Galvanized Steel: 0.022 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION- GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

SECTION 07600 - FLASHING AND SHEET METAL

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal joints as shown and as required for watertight construction.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.

SECTION 07600 - FLASHING AND SHEET METAL

2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 4. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.
- G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.2 UNDERLAYMENT INSTALLATION

- A. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
- B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

SECTION 07600 - FLASHING AND SHEET METAL

1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
 2. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.
- C. Built-in Gutters: Join sections with riveted and soldered or lapped joints sealed with sealant. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.
1. Install felt underlayment layer in built-in gutter trough and extend to drip edge at eaves and under felt underlayment on roof sheathing. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails. Install slip sheet over felt underlayment.
 2. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

SECTION 07600 - FLASHING AND SHEET METAL

- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 4 Section "Unit Masonry Assemblies."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions.

***** END OF SECTION *****

SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all roof accessories and appurtenant work as needed to construct a complete roofing system with the roof accessories.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 07322 Concrete Roof Tiles
3. Section 07600 Flashing and Sheet Metal
4. Section 07721 Rooftop Fall Protection
5. Section 07780 Skylights
6. Section 07920 Sealants and Caulking
7. Section 09800 Protective Coatings

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 Roofing Contractors Association (NRCA).

1.5 SHOP DRAWINGS AND SAMPLES

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

SECTION 07720 - ROOF ACCESSORIES

1. Manufacturer's specifications, literature, and published installation instructions for each roof accessory, product, or system.
2. Shop drawings for each product showing materials, gauges, sizes, finishes, profiles, fabrication of special shapes, fasteners, and method of attachment to adjacent construction shall be submitted.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

- A. Roof accessories and their installation shall be in accordance with the manufacturer's literature and published specifications for the products indicated.
- B. Sizes indicated are minimum throat size.

2.2 ROOF VENTS

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

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

SECTION 07720 - ROOF ACCESSORIES

- A. Roof Vents: Roof vents shall be provided on lightweight concrete or lightweight insulating concrete and shall be placed in such a manner so that one vent will be used for venting 1,000 square feet of roof fill. No area shall have fewer than 2 vents. Vents shall not be installed in walk pads or other traffic areas. Vent pipes shall have a coat of plastic cement applied at the joint between the vent pipe and the roofing before aggregate is applied. Roof insulation shall be removed from below each vent per NRCA instructions. Roof vents shall be painted to match roofing color.

- B. Roof accessory metal items exposed to the exterior atmosphere shall be painted with a protective coating complying with Section 09800.

**** END OF SECTION ****

SECTION 07721 – ROOFTOP FALL PROTECTION

PART 1 – GENERAL

1.2 WORK OF THIS SECTION INCLUDES

- A. The CONTRACTOR shall provide a roof top walkway system for access the skylights. The walkway shall consists of panels and railing system attached to the roof rafters and shall include all appurtenant Work, complete, in accordance with the CONTRACT DOCUMENTS.
- B. This specification covers all labor, materials, equipment, and services necessary to complete the installation of roof walkway system, as herein specified.

1.3 RELATED WORK

- 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.
 - 7. Section 01300 Submittals
 - 8. Section 05500 Miscellaneous Metals
 - 9. Section 07321 Concrete Roof Tiles
 - 10. Section 07600 Flashing and Sheet Metal
 - 11. Section 07720 Roof Accessories
 - 12. Section 07810 Skylights
 - 13. Section 07920 Sealants and Caulking

1.4 REFERENCES

- D. ANSI A21.1 – Safety Requirements for Floor and Wall Openings, Railings, and Toe Boards
- E. ANSI A58.1 – Minimum Design Loads in Buildings and Other Structures
- F. ANSI A117.1 – Accessible and Useable Buildings and Facilities
- G. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.
- H. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

SECTION 07721 – ROOFTOP FALL PROTECTION

- I. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- J. OSHA 1910.23 – Guarding Floor and Wall Openings and Holes.
- K. UL94 – Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.5 SUBMITTALS

- A. The CONTRACTOR shall submit the following in compliance with Section 01300 - Submittals:
 - 6. Product Data
 - d. Preparation instructions and recommendations
 - e. Storage and handling requirements and recommendations
 - f. Installation methods
 - 7. Shop Drawings, including but not limited to, profiles, sizes, connections, sizes and types of fasteners and accessories, showing fabrication and installation walkway, including plans, elevations, sections, details of components, anchor details, and attachment to adjoining units of work.
 - 8. Project specific guidelines and recommendations.

1.6 QUALITY ASSURANCE

- A. Mock-up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Install in areas designated by RESIDENT ENGINEER.
 - 2. Do not proceed with work until workmanship and installation are approved by RESIDENT ENGINEER.
 - 3. Refinish mock-up area as required.

1.7 DELIVERY, STORAGE, AND HANDLING

- B. Materials delivered to the job site in good condition and adequately protected against damage.
- C. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations

SECTION 07721 – ROOFTOP FALL PROTECTION

1.8 SITE CONDITIONS

- B. CONTRACTOR shall conform to all local, state, and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.
- C. CONTRACTOR shall take field dimensions for rafter placement to verify anchorage before field fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Kee Safety, Inc., which is located at 100 Stradtham Street, Buffalo, NY 14206, Toll FreeTel: 800-851+-5181; Tel: 716-896-4949; web: www.keeklamp.com; or approved equal.

2.2 ROOFTOP WALKWAY SYSTEM

- A. Kee Walk System from Kee Safety, or approved equal.
 - 1. Description: The walkway shall be modular type system that will provide an anti-slip, level surface for decarcated route on a rooftop that uniformly distributes a pedestrian load.
 - 2. The walkway shall be able to accommodate flat, barrel, and pitched roofs and shall also be field adjustable for sloping roofs up to 35 degrees.
 - 3. The system shall be in compliance with
 - a. EN 516, Class 1-C
 - b. Fire-rated to class HB of UL94
 - c. Slip resistance per OSHA Standard 29 CFR 1910.22
 - 4. Bearer bars shall be aluminum.
 - 5. Treads shall be fiberglass reinforced nylon with open tread design to allow for water drainage.
 - 6. The manufacturer shall providea all components for the system including, but not limited to clips, brackets, walkway modules and accessories with appropriate fasteners as indicated or required to match design indicated on the CONSTRUCTION DOCUMENTS for a complete and workable walkway.

SECTION 07721 – ROOFTOP FALL PROTECTION

7. The walkway shall provide access to the pump station skylights. Traverse level walking surface shall be mounted onto sub-frame fixed to roof. Two sections jointed with hinged brackets at rear of assembly, rotating arms at front to level walking surface.
 - a. Modules shall be supplied as required to provide complete installation as shown on the drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies or client specific policies with regard to environment, health and safety.
- B. Prepare substrates using methods recommended by the manufacturer for achieving the best results for the substrate under the project conditions.
- C. Coordinate post setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete and masonry fasteners.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instruction including the following:
 1. Fit exposed connections accurately together to form tight joints. For all connections with fitting, each set screw is to be tightened to .29 foot-pounds of torque.
 2. Perform cutting, drilling, and fitting required for installation of walkway.

**** END OF SECTION ****

SECTION 07810 - SKYLIGHTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install skylights complete with frames, glazing materials, glazing tapes and caps, trim, splice caps, flashings contiguous to the skylights, sealants, security bars, and other accessory items necessary for complete installation as shown on the drawings and herein specified.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 05120 Structural Steel
3. Section 07320 Concrete Roof Tiles
4. Section 07600 Flashing and Sheet Metal
5. Section 07720 Roof Accessories
6. Section 07721 Rooftop Fall Protection
7. Section 07920 Sealants and Caulking

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings indicating methods of construction, location and spacing of anchorage, joinery, finishes, sizes, shapes, thicknesses and alloy of materials, glazing materials and relationship to adjoining work.

1.4 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. California Building Code

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured products shall be delivered in original, unbroken, packages, containers or bundles bearing the manufacturer's label.

SECTION 07810 - SKYLIGHTS

- B. Storage: All products shall be carefully stored on wood blocking in an area that is protected from deleterious elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.
- C. Glass and glazing materials shall be protected during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass and damage to glass and glazing materials from effects of moisture, including condensation, of temperature changes, of direct exposure to the sun, and from other causes.

PART 2 – MATERIALS

2.1 MATERIALS

- A. Curb mounted skylight shall be constructed of extruded aluminum frame with full 90 degree openable section as manufactured by Insula-Dome Skylights, or approved equal.
 - 1. Domes: Shall be molded one piece unit with integral counterflashing skirt, without dependencies on gaskets or sealants. Domes shall be dual glazed, bronze color acrylic.
 - 2. Dome frame material shall be 6063-T5 extruded aluminum, minimum thickness of .080. Provide a self-contained sloping condensation and weepage gutter for drainage. Color of finish as selected by the RESIDENT ENGINEER.
 - 3. Exterior fasteners shall be aluminum alloy 2024-T4.
 - 4. Interior fasteners for attaching skylights to surrounding construction shall be cadmium plated steel.

2.2 FABRICATION

- A. Skylights shall be factory fabricated and pre-assembled.

PART 3 – EXECUTION

3.1 FIELD DIMENSIONS

- A. Verify field dimensions and adjust skylight construction and glazing to field conditions.

3.2 INSTALLATIONS

- A. Install skylight units plumb, true, without warping or racking of panels, and without waves or buckling.

SECTION 07810 - SKYLIGHTS

- B. Exercise care in the drilling of anchorage holes to obtain full rated strength from attachment devices.

**** END OF SECTION ****

SECTION 07905 - JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
1. Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
 2. Exterior joints in horizontal traffic surfaces.
 3. Interior joints in vertical surfaces and horizontal non-traffic surfaces.
 4. Interior joints in horizontal traffic surfaces.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
1. Section 01300 Submittals
 2. Section 05120 Structural Steel
 3. Section 07322 Concrete Roof Tiles
 4. Section 07600 Flashing and Sheet Metal
 5. Section 07720 Roof Accessories
 6. Section 07721 Rooftop Fall Protection
 7. Section 07800 Skylights
 8. Section 079551 Sealants and Caulking
 9. Section 08710 Finish Hardware

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.4 REFERENCES

- A. EPA Method 24: Determination of volatile matter content, water content, density, volume solids and weight solids of surface coatings.

SECTION 07905 - JOINT SEALERS

1.5 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 – Submittals.
- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Preconstruction field test reports.
- D. Compatibility and adhesion test reports.

1.7 QUALITY ASSURANCE

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 2 years from date of Substantial Completion.

SECTION 07905 - JOINT SEALERS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

SECTION 07905 - JOINT SEALERS

- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Single-Component Neutral- and Basic-Curing Silicone Sealant:
 - 1. Available Products:
 - a. Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Tremco; Spectrem 1 (Basic).
 - d. GE Silicones; SilPruf SCS2000.
 - e. Pecora Corporation; 864.
 - f. Pecora Corporation; 890.
 - g. Polymeric Systems Inc.; PSI-641.
 - h. Sonneborn, Division of ChemRex Inc.; Omniseal.
 - i. Tremco; Spectrem 3.
 - j. Dow Corning Corporation; 791.
 - k. Dow Corning Corporation; 795.
 - l. GE Silicones; SilPruf NB SCS9000.
 - m. GE Silicones; UltraPruf II SCS2900.
 - n. Pecora Corporation; 865.
 - o. Pecora Corporation; 895.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 100/50.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - 6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and

SECTION 07905 - JOINT SEALERS

openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Available Products:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

SECTION 07905 - JOINT SEALERS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 2. Remove laitance and form-release agents from concrete.
 - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and

SECTION 07905 - JOINT SEALERS

depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

SECTION 07905 - JOINT SEALERS

- I. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

***** END OF SECTION *****

SECTION 07920 - SEALANTS AND CAULKING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing sealants, caulking, and accessories.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 7600 Flashing and Sheet Metal
3. Section 07720 Roof Accessories
4. Section 07800 Skylights
5. Section 08800 Glazing
6. Section 08110 Steel Doors & Frames

1.3 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Building Code

1.4 SPECIFICATIONS AND STANDARDS

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

Federal Specification	Title
TT-S-001543A	Sealing Compound, Silicone Rubber Base, (For Caulking Caulking, Sealing and Glazing in Buildings and Other Structures).
TT-S-00230C(2)	Sealing Compound, Elastomeric Type, (For Caulking Sealing, and Glazing in Buildings and Other Structures).

SECTION 07920 - SEALANTS AND CAULKING

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 installation instructions.
 - 3. Certification that products comply with indicated requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

- A. General: Only products certified as complying with the indicated requirements shall be provided.
- B. Products: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. Manufacturer's Recommendations: Products shall be recommended by the manufacturer for the application indicated.

2.2 SEALANTS AND CAULKING MATERIALS.

- A. Caulking and sealing materials shall conform to the following requirements:
 - 1. Sealant for exterior and interior use shall be 2-part polyurethane, gun grade.
 - 2. Sealants used with aluminum doors, windows, and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A).
 - 3. Fire-resistant penetration sealants shall be a medium density fire-resistant foam that retains form and stability at high temperature and meets UL test requirements for fire rating required at location used.
 - 4. Caulking tapes shall be of the butyl-base, vulcanized type.

SECTION 07920 - SEALANTS AND CAULKING

5. Filler material shall be resilient, closed-cell polyethylene foam and/or bond breakers of proper size for joint widths and shall be compatible with sealant manufacturer's product.
6. Primers shall be as recommended by the manufacturer for caulking and sealants.
7. Cleaning and cleanup solvents shall be as recommended by the manufacturer for caulking and sealants.

2.3 MANUFACTURERS

A. Products shall be of the type and manufacture as indicated below (or equal):

1. Sealant for Exterior and Interior Use:
Products Research Corp. "210"
Progress Unlimited "Iso-Flex 2000"
2. Sealant for Interior Use:
Tremco's "Mono"
Dap "One-Part Acrylic"
3. Fire-resistant Penetration Sealant:
Dow-Corning Corporation's "3-6548 Silicone RTV" foam
3M Corporation's "Fire Barrier Caulk CP 25"
Putty Corporation's "Fire Barrier Caulk CP 25"
Putty Corporation's "303"

PART 3 - EXECUTION

3.1 GENERAL

- A. General: Products shall be installed in accordance with the manufacturer's installation instructions.
- B. Authorized Installers: Caulking and sealants shall be complete systems, and shall be installed only by installers authorized and approved by the manufacturer.
- C. Acoustic Partition Joints: Acoustic partition joints shall be made air and sound-tight with acoustic caulking material.

SECTION 07920 - SEALANTS AND CAULKING

3.2 SEALANT FILLED JOINTS

- A. Manufacturer's Representative: The WORK includes the services of the sealant manufacturer's representative (prior to sealant work) for inspection of the joints and for instructing the installer in the proper use of the materials.
- B. Surface Preparation: Joints and spaces to be sealed shall be clean, dry, and free of dust, loose mortar, and other foreign materials. Ferrous metal surfaces shall be cleaned of rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's recommendations. Protective coatings shall be removed from aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
- C. Sealant Depth: Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. Joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- D. Joints In Porous Materials: Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.
- E. Applications: A full bead of sealant shall be applied to the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint to ensure forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless otherwise indicated.
- F. Cleaning: After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or unstained condition. On porous surfaces, excess sealant shall be removed in accordance with the sealant or caulking manufacturer's printed instructions.

3.3 ACOUSTIC CAULKING

- A. Preparation: Joints and surfaces shall be clean, dry, and free of loose materials.

SECTION 07920 - SEALANTS AND CAULKING

- B. Concealed Joints: Concealed joints in acoustic partitions including perimeters, intersections of walls and penetrations through finish work, and at conduit ends with boxes shall be sealed with acoustic caulking compound. Backs of electrical boxes shall be sealed with acoustic sheet caulking installed over holes and knock-outs.

**** END OF SECTION ****

SECTION 08110 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish and install all standard factory finished hollow metal doors and frames, and related items, complete and operable, including all finish hardware and all appurtenant work, all in accordance with the requirements of the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 01300 Submittals
 - 2. Section 05120 Structural Steel
 - 3. Section 07920 Sealants and Caulking
 - 4. Section 08800 Glazing

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.4 REFERENCES

- A. SDI 117: Manufacturing Tolerances for Standard Steel Doors and frames
- B. SDI A250.4: Test Procedure & Acceptance Criteria for Physical Endurance for Steel Doors & Hardware Reinforcing
- C. SDI A250.8: Recommended Specifications for Standard Steel Doors and Frames

1.5 DEFINITIONS

- A. ASTM: American Society for Testing and Materials
- B. SDI: Steel Deck Institute
- C. DHI: Door and Hardware Institute
- D. NFPA: National Fire Protection Association

SECTION 08110 - STEEL DOORS AND FRAMES

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Manufacturer's Literature: Manufacturer's literature and any engineering calculations that may be required elsewhere in this Section shall be submitted. Calculations by a registered civil or structural engineer shall be submitted showing that the doors, frames, and their structural connections are designed to meet code requirements and loads
- D. Sound Doors and Frames: Shop drawings, manufacturer's literature, installation recommendations, and certification of Sound Transmission Class (STC) rating shall be submitted for all sound door and frame assemblies
- E. Samples for Initial Selection: For units with factory-applied color finishes.
- F. Samples for Verification: For each type of exposed finish required.
- G. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Doors and frames shall be shipped and stored with temporary stiffeners and spacers in place to prevent distortion.
- B. Doors and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- C. Doors and frames shall be carefully stored on wood blocking in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld Building Products, LLC.
 - 2. Benchmark; a division of Therma-Tru Corporation.
 - 3. Ceco Door Products; an Assa Abloy Group company.

SECTION 08110 - STEEL DOORS AND FRAMES

4. Curries Company; an Assa Abloy Group company.
5. Kewanee Corporation (The).
6. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I.
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

2.3 FABRICATION - GENERAL

- A. Shop Fabrication and Assembly: All steel doors and frames shall be shop fabricated and shop assembled, where possible. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and accurate erection shall be provided. After fabrication, all tool marks and other surface imperfections shall be filled and ground smooth.
- B. Hardware: Doors and frames shall be reinforced and drilled or tapped for fully templated mortised hardware; and shall be reinforced with plates for surface-mounted hardware, meeting ANSI A115 Series requirements. Hardware shall be as specified in Section 08710 - Door Hardware, and/or as shown

2.4 STANDARD HOLLOW METAL DOORS

SECTION 08110 - STEEL DOORS AND FRAMES

- A. General: Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Thermal-Rated (Insulated) Doors: R-value of not less than 12.3 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge, 1/8 inch in 2 inches..
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
 - 5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- C. Hardware Reinforcement: ANSI/SDI A250.6.
- D. Transom Panels: Transom panels shall be provided where indicated and shall comply with the requirements for doors.

2.5 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.6 FRAME ANCHORS

SECTION 08110 - STEEL DOORS AND FRAMES

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.7 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- B. Terminated Stops: Where indicated, terminate stops 6 inches above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.8 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
 - 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

SECTION 08110 - STEEL DOORS AND FRAMES

3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
- D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Finish Hardware Schedule and templates furnished as specified in Section 08710 "Finish Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 electrical Sections.
- E. Stops and Moldings: Provide stops and moldings where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide loose stops and moldings on inside of hollow metal work.
 2. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

- A. Factory-Applied Paint Finish: ANSI/SDI A250.3.

SECTION 08110 - STEEL DOORS AND FRAMES

1. Color and Gloss: As selected by the RESIDENT ENGINEER from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.
 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

SECTION 08110 - STEEL DOORS AND FRAMES

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

SECTION 08110 - STEEL DOORS AND FRAMES

- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
- d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

***** END OF SECTION *****

SECTION 08520 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing aluminum windows with frames, bracing, glazing attachments, screens, hardware, accessories and attachments, erection and accessories.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 07920 Sealants and Caulking
3. Section 08800 Glazing

1.3 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. California Building Code

1.4 SPECIFICATIONS AND STANDARDS

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

1. ASTM E 283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
2. ASTM E 330 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
3. ANSI/AAMA 101 Voluntary Specification for Aluminum Sliding Doors and Windows
4. ASTM E 331 Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

SECTION 08520 - ALUMINUM WINDOWS

5. AA-Finishes Aluminum Association, "Designation System for Aluminum Finishes"

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:
 1. Manufacturer's catalog indicating the type of products proposed for installation
 2. Elevations of each window type along with detailed cross references
 3. Details of window and frame construction along with metal gauges and fasteners
 4. Methods of anchorage
 5. Glazing and weatherstripping details
 6. Drawings showing locations of hardware and provision and reinforcement for hardware
 7. Schedule showing location and size of each window
 8. Calculations by a registered civil or structural engineer showing that the window, window walls, entrances, and storefront systems and their structural connections are designed to meet code requirements and loads.

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL:
 1. Detail specifications and instructions for installation, adjustments, cleaning and maintenance instructions.
 2. Test report by certified independent testing laboratory verifying compliance with test requirements.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.8 FACTORY INSPECTION AND TESTING

SECTION 08520 - ALUMINUM WINDOWS

- 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 RESIDENT ENGINEER-designated inspectors for 2days 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. Windows and component structural tests shall conform to the "Voluntary Guide Specification for Aluminum Architectural Windows" as published by AAMA unless more stringent requirements are indicated.
- C. The windows shall equal or exceed the ANSI/AAMA 101 Class HS-HC-40 and/or HS-DW-HC40 specifications of the Architectural Aluminum Manufacturers Association.
- D. Testing shall comply with ASTM E 283 and E 330 and shall include:
 - 1. Air Infiltration Test (Perform before Water Test)(ASTM E 283) (0.37 max. @1.57 lbf/sq ft)
 - 2. Water Resistance Test (ASTM E 331) (@6.00 lbf/sq ft)
 - 3. Uniform Load Deflection Test (ASTM E 330) (@60 lbf/sq ft)
 - 4. Uniform Load Structural Test (ASTM E 330) (@60 lbf/sq ft)
 - 5. Thermal Transmittance Test (AAMA 1503-1) ("U Value Class" U50 min.)
 - 6. Condensation Factor (CRF-Class C-50) AAMA 1502.7

PART 2 - PRODUCTS

2.1 GENERAL

- A. Products: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

2.2 MATERIALS

- A. Aluminum windows and components shall be:
 - 1. Extruded aluminum prime billet 6063T5.
 - 2. Aluminum sheet 5005 H34.

SECTION 08520 - ALUMINUM WINDOWS

3. Principal window member minimum wall thicknesses shall be as necessary to meet design force requirements.
- B. Hardware shall comply with the following:
1. Steel components, shall be 300 series stainless steel: strikes, pins, axles, screws, fasteners and similar products.
 2. Aluminum components, 6063T5.
 3. Locking handles and cases shall be dark oil rubbed bronze or stainless steel having a finish color similar to window units.
 4. Windows shall include inside locking (positive locking more than just latching) hardware or accessory hardware to prevent the window from being opened from outside if glass is broken.

2.3 FABRICATION

- A. General: Frame and sash members shall be fabricated into complete windows under responsibility of one manufacturer. Window units shall bear Certification Label.
- B. Sash: Vertical sash members shall be hollow tubular extrusions to resist torsion. Sash corners shall be milled and telescoped for maximum strength. Vent sash shall roll on grease packed ball bearing rollers having nylon tires. Screws, fasteners, axles, and pins shall be stainless steel.
- C. Frame: Frames shall be constructed of continuous extrusions, with miter cut corners with each corner mechanically fastened with not less than two screws and sealed watertight.
- D. Joinery: Joinery methods shall not discolor finish or be unsightly.
- E. Finish: Exposed surfaces of all aluminum windows and trim shall have an architectural Class I AA-M10-C22-A- 41 clear (0.7 mil minimum thickness) anodized finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of window units, and other components of the work shall comply with the manufacturer's specifications and written recommendations.
- B. Unit sets shall be set plumb, level, and true to line, without warp or rack of frames. Anchor shall be securely in place. Aluminum and other corrodible surfaces shall be separated from sources of corrosion or electrolytic action at points of contact with other materials.

SECTION 08520 - ALUMINUM WINDOWS

- C. The aluminum surfaces and glazing shall be cleaned prior to project acceptance.
- D. The WORK of this Section includes precautions required through remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering, at time of acceptance.
- E. Trademarks: Trademarks, nameplates, or similar items shall not be visible nor attached to the installation.
- F. Protection: After installation and erection, exposed surfaces and finishes shall be protected from damage.

3.2 CLEANUP AND DISPOSAL

- A. After completion of the installation, the unit shall be tested for water leaks and protected.
- B. Prior to acceptance by the RESIDENT ENGINEER, the CONTRACTOR shall clean the WORK of this Section as recommended by the product manufacturer.

**** END OF SECTION ****

SECTION 08710 - FINISH HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work hereunder shall include all fabrication and mounting templates as needed for fabricators and for control or application of metal items.
- B. In addition thereto, the CONTRACTOR shall provide and install all trim, attachments, and fastenings specified or required for proper and complete installation. The work of this Section shall include all hardware that is not specified in other Sections, whether or not such hardware is herein specifically scheduled
- C. The CONTRACTOR shall protect the finish hardware from damage during construction, painting, and clean-up

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work:
 - 1. Section 01300 Submittals
 - 2. Section 05120 Structural Steel
 - 3. Section 07905 Joint Sealants

1.3 REFERENCES

- A. NFPA 101: Life Safety Code
- B. NFPA 80: Standard for Fire Doors and Other Opening Protective
- C. DHI A115 Series: Installation guide for doors and hardware

1.4 DEFINITIONS

- A. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association
- B. CDA: Copper Development Association
- C. BHMA: Builders Hardware Manufacturers Association
- D. NFPA: National Fire Protection Association

1.5 SUBMITTALS

- A. Submit in accordance with Section 01300 – Submittals.

SECTION 08710 - FINISH HARDWARE

- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Details of electrified door hardware, including wiring diagrams.
- D. Samples: For each exposed finish.
- E. Product certificates.
- F. Other Action Submittals:
 - 1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.
 - a. Content: Include the following information:
 - 1) Identification number, location, hand, and material of each door and frame.
 - 2) Type, style, function, size, quantity, and finish of each door hardware item.
 - 3) Complete designations of every item required for each door or opening including name and manufacturer.
 - 4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing RESIDENT ENGINEER's final keying instructions for locks.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door consulting with Contractor and RESIDENT ENGINEER about door hardware and keying.
- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

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- C. Keying Conference: Conduct conference at Project site to comply with the requirements below. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.

1.7 PACKING, MARKING, AND DELIVERY

- A. All locks, exit devices, door closers, overhead door holders, hinges, kickplates, pulls and push plates, thresholds, and other similar items shall be individually packed in separate, suitable, original, containers as furnished by the hardware manufacturers. Each container shall be clearly marked with item numbers, article numbers, and names corresponding to those listed in the hardware schedule.
- B. Small miscellaneous items that would not require specific location identifications, such as door stops, and door silencers may be quantity packed if properly labeled with item numbers and other identification.
- C. CONTRACTOR shall check the hardware upon delivery with the aid of a representative of the hardware's supplier's firm. The CONTRACTOR shall be responsible for the proper storage of all hardware until ready for application.
- D. Deliver keys to manufacturer of key control system for subsequent delivery to the RESIDENT ENGINEER.
- E. Deliver keys and permanent cores to RESIDENT ENGINEER by registered mail.

1.8 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion, except as follows:
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

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- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
 - 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES- GENERAL

- A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior Hinges: Stainless steel, with stainless-steel pin.
- C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors.
- D. Fasteners: Comply with the following:
 - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 2. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:

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1. Hager Companies (HAG).
2. IVES Hardware; an Ingersoll-Rand Company (IVS)
3. McKinney Products Company; an ASSA ABLOY Group company (MCK).
4. Stanley Commercial Hardware; Div. of The Stanley Works (STH).

2.4 LOCKS AND LATCHES- GENERAL

- A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 1. Mortise Locks: BHMA A156.13.
- B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1 unless Grade 2 is indicated; Series 1000.
 1. Manufacturers:
 - a. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
- C. Dustproof Strikes: BHMA A156.16, Grade 1.
- D. Surface Bolts: BHMA A156.16, Grade 1 unless Grade 2 is indicated.
 1. Flush Bolt Heads: Minimum of 1/2-inch diameter rods of brass, bronze, or stainless steel with minimum 12-inch long rod for doors up to 84 inches in height. Provide longer rods as necessary for doors exceeding 84 inches.
 2. Available Manufacturers:

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- a. Door Controls International (DCI).
- b. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
- c. Hager Companies (HAG).
- d. IVES Hardware; an Ingersoll-Rand Company (IVS).
- e. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
- f. Trimco (TBM).

2.6 LOCK CYLINDERS

- A. High-Security Lock Cylinders: BHMA A156.30, Grade 1;
 1. Key Control Level: Category A.
 2. Destructive Test Level: Category A.
 3. Surreptitious Entry Resistance Level: Category A.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 1. Number of Pins: Six.
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with interchangeable cores.
- D. Construction Keying: Comply with the following:
 1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
 2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
 - a. Furnish permanent cores to RESIDENT ENGINEER for installation.
- E. Manufacturer: Same manufacturer as for locks and latches.

2.7 KEYING

- A. Keying System: Schlage Everest D and Everest Primus level 9 patented keyway, interchangeable core, Utility patent protection to extend at least until 2014.

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Key blanks only available from factory-direct sources, not available from after-market keyblank manufacturers. For estimate use factory GMK charge. Initiate and conduct meeting(s) with RESIDENT ENGINEER to determine system keyway(s), keybow style, structure, degree of physical security and degree of geographic exclusivity. Furnish RESIDENT ENGINEER written approval of the system.

- B. Keys: Nickel silver
 - 1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five great-grand master keys.

2.8 OPERATING TRIM

- A. Standard: BHMA A156.6.
- B. Materials: Fabricate from stainless steel, unless otherwise indicated.
- C. Available Manufacturers:
 - 1. Burns Manufacturing Incorporated (BM).
 - 2. Hager Companies (HAG).
 - 3. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - 4. Keedex (KEE).
 - 5. Trimco (TBM).

2.9 ACCESSORIES FOR PAIRS OF DOORS

- A. Carry-Open Bars: Provide carry-open bars for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
 - 1. Material: Polished brass or bronze, with strike plate.

2.10 CLOSERS

- A. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- B. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure

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to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4, Grade 1 unless Grade 2 is indicated. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Available Manufacturers:

- a. Arrow USA; an ASSA ABLOY Group company (ARW).
- b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
- c. LCN Closers; an Ingersoll-Rand Company (LCN).
- d. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
- E. Coordinators: BHMA A156.3.

2.11 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.

B. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from material indicated in door hardware sets.

1. Material: 0.050-inch thick stainless steel.

2. Available Manufacturers:

- a. American Floor Products Co., Inc. (AFP).
- b. Baldwin Hardware Corporation (BH).
- c. Hager Companies (HAG).
- d. IVES Hardware; an Ingersoll-Rand Company (IVS).
- e. Trimco (TBM).

2.12 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16, Grade 1 unless Grade 2 is indicated.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will

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impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

- B. Combination Floor and Wall Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.
- C. Combination Overhead Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.

2.13 DOOR GASKETING

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- E. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
- F. Available Manufacturers:
 - 1. Hager Companies (HAG).
 - 2. M-D Building Products, Inc. (MD).
 - 3. Pemko Manufacturing Co. (PEM).

2.14 THRESHOLDS

- A. Standard: BHMA A156.21.

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- B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.
- D. Available Manufacturers:
 - 1. Hager Companies (HAG).
 - 2. Pemko Manufacturing Co. (PEM).
 - 3. Reese Enterprises (RE).

2.15 FABRICATION

- A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.
- C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way,

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coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07905 - "Joint Sealants."
- F. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

***** END OF SECTION *****

SECTION 08800 - GLAZING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all glass, caulking materials, and appurtenant items required for all the glass and glazing work, complete.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 07920 Sealants and Caulking
3. Section 08520 Aluminum Windows

1.3 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. 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. Federal Specifications:

DD-G-451 Glass, Float or Plate, Sheet, Figured (Flat for Glazing, Mirrors and Other Uses)

DD-G-1403 Glass, Float, Sheet, Figured, Coated (Heat-Strengthened and Tempered)

TT-S-001543 Sealing Compound, Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

2. Commercial Standards:

ASTM C 1036 Primary Glass Standard

ASTM C 1048 Heat Treated Glass Standard

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ASTM D 2287	Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 163 (UL 9)	Fire Resistance Rated Wire Glass
ANSI Z 97.1	Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test

3. Trade Standards:

Glazing Standards: CONTRACTOR shall comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except as indicated herein.

Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, CONTRACTOR shall provide the type of products indicated which comply with ANSI Z 97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

Subject to compliance with requirements, CONTRACTOR shall provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted for approval:

1. Product Data: Manufacturer's technical data shall be submitted for each glazing material and fabricated glass product required, including installation and maintenance instructions.
2. Samples: When requested by the RESIDENT ENGINEER, samples shall be submitted for verification purposes, 12-inch square samples of each type of glass indicated except for clear single pane units, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Sealant or gasket sample shall be installed between two strips of material representative of adjoining framing system in color.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:

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1. Certificate: Certificates shall be submitted from respective manufacturers attesting that glass and glazing materials furnished for the project comply with requirements.
 - a. Separate certification shall not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.
2. Compatibility and Adhesion Test Report: A statement shall be submitted from the sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants, and interpreting test results of material performance for recommendations on primers and substrate preparation needed to obtain adhesion.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured products shall be delivered in original, unbroken, packages, containers or bundles bearing the manufacturer's label.
- B. Storage: All products shall be carefully stored on wood blocking in an area that is protected from deleterious elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.
- C. Glass and glazing materials shall be protected during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass and damage to glass and glazing materials from effects of moisture, including condensation, of temperature changes, of direct exposure to the sun, and from other causes.

1.8 SPECIAL WARRANTY

- A. Manufacturer's Special Project Warranty on Coated Glass Products: A written warranty shall be provided, signed by manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, freight allowed to project site, within specified warranty period indicated below, replacements for those coated glass units which develop manufacturing defects. Manufacturing defects shall be defined as peeling, cracking or deterioration in metallic coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.
 1. Warranty Period: Warranty period shall be manufacturer's standard, but not less than 5 years after date of substantial completion.

SECTION 08800 - GLAZING

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturer's Standards: Glass and caulking materials shall be in accordance with the manufacturer's published literature and specifications for the products indicated.
- B. Single Source Responsibility for Glass: Materials shall be provided which are produced by a single manufacturer or fabricator for each kind and condition of glass indicated. Primary glass shall be obtained from a single source for each type and class required.
- C. CONTRACTOR shall provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the WORK.
 - 1. Normal thermal movement shall be defined as that resulting from an ambient temperature range of 120 degrees F (67 degrees C) and from a consequent temperature range within glass and glass framing members of 180 degrees F (100 degree C).
 - 2. Deterioration of coated glass shall be defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

2.2 GLAZING MATERIALS

- A. Glass Specifications:
 - 1. Primary Glass Standard: Primary glass shall comply with ASTM C 1036, including type, class, quality, and, if applicable, form, finish, mesh and pattern.
 - 2. Glass shall conform to Federal Specifications DD-G-451.
 - 3. Tempered glass shall also conform to Federal Specification DD-G-1403 (Tempered Glass).
- B. Sizes: Glass shall be fabricated to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Thicknesses shall be provided as indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

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- C. Glazing Thickness: Thicknesses of glass indicated are minimum thicknesses. Thicker glass shall be provided when required by the Building Code.
- D. Labeling: Glass shall be factory-labeled. Non-labeled glass will be rejected.

2.3 GLASS TYPES

- A. All glass shall conform to the following requirements:
 - 1. Type A - Tinted, Colored Float Glass: Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), not less than 3/16-inch minimum thickness. The glass color shall be gray and as follows:
 - a. Gray: Manufacturer's standard tint, with visible light transmittance of 41-43 percent and shading coefficient of 0.67 - 0.69 percent for 1/4-inch thick glass.
 - 2. Type B - Clear, Fully-Tempered Float Glass: Conform to Federal Specification DD-G-1403C, minimum thickness 1/4-inch. Condition A (uncoated surface), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).
 - a. Heat-treated glass shall be manufactured by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.
 - 3. Type C: Laminated safety glass shall be heat-tempered sheets of clear, heavy float glass, laminated and bonded by heat and pressure to a polyvinyl butyryl plastic interlayer of not less than 0.080-inch thick each. The laminated safety glass shall conform to Federal Safety Standards 16 CFR 1201 and shall meet the requirements of the Safety Glazing Certification Council (SGCC), which complies with ANSI Z 97.1 standards.

Laminated safety glass for the view windows into hydraulic structures shall consist of 3 layers of glass of the following thickness (based on pressure per square foot) for pressure shown:

Up to 1600 psf use 3 lites of 5/8-inch glass;

The sizes and locations of view windows are indicated on Structural Drawings. If no pressures are indicated, the CONTRACTOR shall provide glass for 2600 psf.

2.4 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

SECTION 08800 - GLAZING

- A. General: Products shall be provided of type indicated and complying with the following requirements:
1. Compatibility: Glazing sealants and tapes shall be selected of proven compatibility with other materials with which they will come into contact, including glass products, seals of Insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 2. Suitability: Recommendations of sealant and glass manufacturers shall be complied with for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 3. Elastomeric Sealant Standard: Manufacturer's standard chemically curing, elastomeric sealant shall be provided of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
 4. Colors: Color of exposed sealants shall be provided as indicated or, if not otherwise indicated, as selected by RESIDENT ENGINEER from manufacturer's standard colors.
- B. Two-Part Polysulfide Glazing Sealant: Type M; Grade NS; Class 25; Uses NT, M, G, A, and as applicable, to uses indicated, O.
- C. One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable, to uses indicated, O; conforming to Federal Specifications TT-S-001543A non-sag type, and complying with the following requirements for modulus and additional joint movement capability.
1. Low Modulus: Tensile strength of 45 psi or less at 100 percent elongation when tested per ASTM D 412 after 14 days at 77 degrees F (20 degrees C) and 50 percent relative humidity.
- D. Preformed Butyl-Polyisobutylene Glazing Tape: Manufacturer's standard solvent-free butyl-polyisobutylene formulation shall be provided with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. Compatibility: Materials shall be provided with proven record of compatibility with surfaces contacted in installation.

SECTION 08800 - GLAZING

- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene, EPDM or silicone blocks shall be provided as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions shall be provided as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.
- E. Edge Blocks: Neoprene, EPDM or silicone blocks shall be provided as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement of glass.
- F. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock shall be provided of synthetic rubber or plastic foam, flexible and resilient, with 5 to 10 psi compression strength for 25 percent deflection.

2.6 MANUFACTURERS

- A. Products of the type indicated shall be of the following manufacture (or equal):
 - 1. Glazing Accessory Products:
 - a. Two-Part Polysulfide Glazing Sealant:
 - "Chem-Calk 200"; Bastik Construction Products Div.
 - "Synthacalk GC-5"; Pecora Corp.
 - b. One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:
 - "Dow Corning 795"; Dow Corning Corp.
 - "Silpruf"; General Electric Corp.
 - "Gesil"; General Electric Corp.
 - "Spectrum 2"; Tremco, Inc.
 - c. Preformed Butyl-Polyisobutylene Glazing Tape without Spacer Rod:
 - "Chem-Tape 40"; Bastik Construction Products Div.
 - "Extru-Seal"; Pecora Corp.

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"PTI 303" Glazing Tape; Protective Treatments, Inc.

"Tremco 440 Tape"; Tremco, Inc.

2. Glass Products:

a. Clear and Tinted Float Glass:

AFG Industries, Inc.

Ford Glass Division

Guardian Industries Corp.

LOF Glass, Inc.

PPG Industries, Inc.

Saint-Gobain/Euroglass

b. Heat-Treated Glass:

AFG Industries

Cardinal IG

Environmental Glass Products

Falconer Glass Division

Ford Glass Division

Guardian Industries Corp.

Hordis Brothers, Inc.

LOF Glass, Inc.

PPG Industries, Inc.

Saint-Gobain/Euroglass

Spectrum Glass Prod. Div., H.H. Robertson Co.

Viracon, Inc.

c. Laminated Glass:

Advanced Coating Technology

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Environmental Glass Products

Falconer Glass Industries

Ford Glass Division

Guardian Industries Corp.

Hordis Brothers, Inc.

PPG Industries, Inc.

Saint-Gobain/Euroglass

Viracon, Inc.

PART 3 - EXECUTION

3.1 GENERAL

- A. Reference Standards: Products shall be installed in accordance with manufacturer's recommendations and referenced glazing standards except where more stringent requirements are indicated herein.
- B. Complete System: Glass and glazing system shall be installed complete with all stops, blocks, channels, beads, sealants, and glass to form a completely installed watertight installation.
- C. Glazing channel dimensions as indicated are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses with reasonable tolerances. Glazier shall adjust as required by job conditions at time of installation.
- D. Pre-Inspection: CONTRACTOR shall require glazier to inspect WORK of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. CONTRACTOR shall obtain glazier's written report listing conditions detrimental to performance of glazing WORK. CONTRACTOR shall not allow glazing WORK to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preparation work such as priming and cleaning shall be done with materials and procedures specified in the printed recommendations of the manufacturer. Surfaces shall be dry and free from dust, dirt, and film. All priming shall be completed and thoroughly dried before glazing.

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- B. Glazing channels and other framing members shall be thoroughly cleaned to receive glass, immediately before glazing. Coating which are not firmly bonded to substrates shall be removed. Lacquer shall be removed from metal surfaces where elastomeric sealants are indicated for use.

3.3 INSTALLATION

- A. Glass shall be protected from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Glass shall not be impacted against metal framing. Suction cups shall be used to shift glass units within openings; pry bar shall not be used to raise or drift glass. Glass shall be rotated with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening.
- B. Concealed edges of glass shall be clean, straight cut, and free from chips and fissures. All glass shall be shop-cut, with proper allowance of size for installed lite. Allow for maximum grip on all edges. Glass shall be set with equal bearing on entire width of pane. Nipping glass on the job site will not be allowed. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.
- C. Weather and Temperature Limitations: No WORK of this Section shall be performed in damp, foggy, or rainy weather. WORK shall not proceed unless temperatures are within manufacturer's printed recommendations.
- D. Units of glass shall be set in each series with uniformity of pattern, draw, bow and similar characteristics.
- E. Glazing Beads: Glass in glazing beads or channels shall be in accordance with manufacturer's printed installation instructions. Materials shall not be stretched.
- F. Metal Glazing Beads: Where metal glazing beads or stops occur and where vinyl glazing beads are not used, the glass shall be set on setting blocks and be completely bedded in glazing compound. Metal glazing beads furnished by the manufacturer shall be installed in accordance with manufacturer's printed instructions. Compound shall be trimmed flush to sight line.
- G. Gasket Glazing: Glass set in a reglet with gasket glazing shall be set on glazing tape. All voids around the perimeter and between glass and stop shall be filled with glazing compound to provide completely watertight installation. Tape and compound shall be trimmed flush to sight line.
- H. Sealant Application: Sealant shall be applied on the inside glass surface below the glazing bead. The void below vinyl to bottom of glazing reglet shall be filled to maintain a weathertight seal.

SECTION 08800 - GLAZING

1. Compressible filler rods or equivalent back-up material shall be provided as recommended by sealant and glass manufacturers to prevent sealant from extruding into glass channel weep systems and from adhering to joints' back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.
 2. Sealants shall be forced into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
 3. Exposed surfaces of sealants shall be tooled to provide a substantial "wash" away from glass. Pressurized tapes and gaskets shall be installed to protrude slightly out of channel to eliminate dirt and moisture pockets.
- I. Setting blocks of proper size shall be installed in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6 inches from corner, unless otherwise required. Blocks shall be set in a thin course of sealant which is acceptable for heel bead use.
 - J. Spacers shall be provided, inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. 1/8-inch minimum bite of spaces shall be provided on glass and thickness equal to sealant width shall be used, except with sealant tape, thickness shall be employed which is slightly less than final compressed thickness of tape.
 - K. Edge blocking shall be provided to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
 - L. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, adequate anchorage shall be provided to ensure that gasket will not "walk" out when installation is subjected to movement.
 - M. Wedge-shaped gaskets shall be miter-cut at corners and gaskets shall be installed in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
 - N. Safety Markings: Glass, glazing panels, and glazing shall be protected by markings or devices which clearly indicated the presence of glass to other workers and materials handlers. Taping or marking which would cause a permanent stain on the glass shall not be used. Labels shall remain on the glass until final cleaning.

SECTION 08800 - GLAZING

3.4 TESTING

- A. After installation is complete, all exterior glazing, except for aluminum entrance doors, shall be given a leak test by flooding the installed surfaces from bottom to top, using 3/4-inch minimum hose with nozzle.

3.5 ACCEPTANCE AND CLEANING

- A. Glass shall be protected from contact with contaminating substances resulting from construction operations. If contaminating substances come into contact with glass, they shall be removed immediately by method recommended by glass manufacturer.
- B. Glass surfaces adjacent to or below exterior concrete and other masonry surfaces shall be examined at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, they shall be removed by a method recommended by glass manufacturer.
- C. Glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period shall be removed and replaced.
- D. Not more than 4 days prior to final acceptance of the WORK, nonpermanent labels shall be removed and the surfaces shall be cleaned. Glass shall be washed on both faces by method recommended by glass manufacturer.

**** END OF SECTION ****

SECTION 09800 – PROTECTIVE COATING

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. 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 install protective coating measures in accordance with these specifications and other design criteria referenced in the CONTRACT DOCUMENTS to ensure all systems are protected.
- B. Definitions:
1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 2. The term "DFT" means minimum dry film thickness.
- C. The following surfaces shall not be protective coated unless specifically indicated in other Sections or on the Drawings.
1. Concrete.
 2. Stainless steel.
 3. Machined surfaces.
 4. Grease fittings.
 5. Glass.
 6. Equipment nameplates.
 7. Platform gratings, stair treads, door thresholds, and other walking surfaces.
 8. Plastic and fiberglass surfaces
 9. Embedded steel in concrete.
 10. Factory pre-finished surfaces with baked-on enamel, porcelain, polyvinylidene fluoride or other similar heat-applied factory finish.
 11. Submerged or intermittently submerged concrete unless otherwise specified.

SECTION 09800 – PROTECTIVE COATING

- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 02630 Ductile Iron Pipe
3. Section 02645 PVC Pressure Pipe (4 in. and Smaller)
4. Section 02646 PVC Pressure Pipe (Larger than 4-inch)
5. Section 02650 Steel Pipe, Lined and Coated
6. Section 02653 Fabricated Steel Pipe Specials
7. Section 05120 Structural Steel
8. Section 05500 Miscellaneous Metals
9. Section 11209 Submersible Sump Pumps
10. Section 11214 Vertical Turbine Pumps
11. Section 11220 Reservoir Sample Pump/Mixer
12. Section 15020 Pipe Supports
13. Section 15103 Globe Valves
14. Section 15104 Butterfly Valves
15. Section 15105 Check Valves
16. Section 15109 Gate Valves
17. Section 15113 Air Release and Vacuum Valves
18. Section 14114 Pressure Regulating Valves

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19. Section 15115 Miscellaneous Valves
20. Section 15117 Pump Control Valves
21. Section 16040 Electric Motors
22. Section 16200 Engine Generator

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. References herein to "SSPC Specifications" or "SSPC" shall mean the published standards of SSPC, the Society for Protective Coatings.
2. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers.
3. References herein to "ANSI/AWWA" shall mean the published standards of the American Water Works Association including:
 - a. ANSI/AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe B 4 in. (100mm) and Larger - Shop Applied
 - b. ANSI/AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
 - c. ANSI/AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - d. ANSI/AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 - e. ANSI/AWWA C214 Tape Coating Systems for the Exterior of Steel Water Pipelines
 - f. ANSI/AWWA C216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and with Fittings for Steel Water Pipelines

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- g. ANSI/AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines
 - 4. Federal Specifications:
 - OSHA 1910.144 Safety Color Code for Marking Physical Hazards
 - 5. National Sanitation Foundation “NSF,” Standard 61 for Contact with Drinking Water.
 - 6. ASTM Standards:
 - a. C-309 Liquid Membrane-Forming Compounds for Curing Concrete
 - 7. Regulatory Agency Requirements: Coatings for surfaces in contact with raw or potable water shall impart no taste or odor to the water nor result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations including NSF Standards. All coatings shall be approved by the San Diego Air Pollution Control District. The CONTRACTOR shall revise painting systems specified herein to provide manufacturer’s regulatory agency approved coating system where required. All painting systems shall be VOC. compliant.
- B. The Work of this Section shall comply with the current edition of the Uniform Building Code as adopted by the City of San Diego.
 - C. Inspection records of shop or field-applied coatings and linings for buried or submerged items shall be submitted within 15 days after the work has been accepted.
- 1.4 CONTRACTOR SUBMITTALS
- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals unless indicated otherwise below.
 - B. Submittals shall include the following information and be submitted at least 30 days before protective coating work:
 - 1. Coating Materials List: Eight copies of a coating materials list showing the Manufacturer and the coating number, keyed to the coating systems herein. The list shall be submitted before or at the time of submittal of samples.

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2. Paint Manufacturer's Information: For each coating system to be used, the following data:
 - a. Paint manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Paint manufacturer's instructions and recommendations on surface preparation and application.
 - d. Proposed application techniques including proof of the acceptability of the proposed technique for each coating.
 - e. Colors available for each product (where applicable).
 - f. Compatibility of shop and field applied coatings (where applicable).
 - g. Material Safety Data Sheet for each product used.

1.5 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. Warranty Inspection: A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these Specifications and to the satisfaction of the RESIDENT ENGINEER. The RESIDENT ENGINEER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the 2-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the CONTRACT DOCUMENTS.

1.6 SERVICES OF MANUFACTURER

- A. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:
 1. The manufacturer's representative shall furnish at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application and curing of the coating systems.
 2. The manufacturer's representative shall personally observe the start of surface preparation, mixing, and application of the coating materials.

SECTION 09800 – PROTECTIVE COATING

3. The manufacturer's representative shall provide technical support in the field to resolve field problems associated with manufacturer's products furnished under this Contract or the application thereof.

1.7 SAFETY AND HEALTH REGULATIONS

- A. General: In accordance with the requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the CONTRACTOR shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the Work. In addition, workers engaged in or near the work during sandblasting shall wear OSHA approved eye and face protection devices and air purifying, halfmask or mouthpiece respirators. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall implement furnish and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while Work is in progress, which may include explosion-proof lights, scaffolding and electrical equipment. Whenever required by the RESIDENT ENGINEER, 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 RESIDENT ENGINEER.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the RESIDENT ENGINEER to facilitate inspection and shall be moved by the CONTRACTOR to locations as requested by the RESIDENT ENGINEER.

PART 2 -- PRODUCTS

2.1 GENERAL

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- 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 RESIDENT ENGINEER. 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 RESIDENT ENGINEER.
- E. Substitute or "Or-Equal" Products:
 - 1. To establish equality, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
 - a. Quality.
 - b. Durability.
 - c. Resistance to abrasion and physical damage.
 - d. Life expectancy.
 - e. Ability to recoat in future.
 - f. Solids content by volume.
 - g. Dry film thickness per coat.
 - h. Compatibility with other coatings.
 - i. Suitability for the intended service.
 - j. Resistance to chemical attack.
 - k. Temperature limitations in service and during application.
 - l. Type and quality of recommended undercoats and topcoats.
 - m. Ease of application.
 - n. Ease of repairing damaged areas.

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- 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 RESIDENT ENGINEER 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 RESIDENT ENGINEER shall be paid by the CONTRACTOR at no additional cost to the OWNER. If a proposed substitution requires changes in the Work, bear all such costs involved and the costs of allied trades affected by the substitution at no additional cost to the OWNER.

2.2 INDUSTRIAL COATING SYSTEMS

- A. Material Sources: Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials will be considered as indicated above. All industrial coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
 - 1. Ameron International.
 - 2. Carboline Coatings Company.
 - 3. ICI Devoe Coatings Company.
 - 4. Glidden Coatings and Resins.
 - 5. Inorganic Coatings, Inc.
 - 6. International Protective Coatings.
 - 7. Tnemec Company.

2.3 COLORS AND FINISHES

- A. Surface treatments and finishes are shown under "Coating Systems" below. All substrates scheduled under "Coating Systems" shall be coated whether or not shown on the Drawings or in the Coating System Schedule, unless an item is specifically scheduled as not requiring one of the coating systems described in this Section.
- B. Color Selection

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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 CONTRACT DOCUMENTS.
- C. Color Pigments: Color pigments shall be pure, nonfading, applicable types to suit the substrates and service indicated. Lead content shall not exceed amount permitted by federal, state and local government laws and regulations.

2.4 COATING SYSTEMS

A. Interior and Exterior Systems

1. System No. 1 - Aliphatic Polyurethane: Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two-component epoxy coating with a minimum solids content of 68 percent by volume.
 - a. Prime coat DFT = 4 mils, Ameron 385, Carboline 893, Tnemec 69, or equal.
 - b. Finish coat (1 or more, DFT = 3 mils), Ameron Amershield, Carboline 134 HS, Tnemec 74, or equal.
 - c. Total system DFT = 7 mils.
 - d. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
2. System No. 2 - Epoxy, Equipment and Piping: Two-component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 66 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.
 - a. Prime coat DFT = 3 mils, Ameron 385, Tnemec 69, or equal.
 - b. Prime coat, where shop applied. (DFT = 3 mils), universal primer, Ameron 185 HS, Tnemec 50-330 or 161, or equal.

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- c. Finish coats (2 or more, DFT = 6 mils), Ameron 385, Tnemec 69, or equal.
 - d. Total system DFT = 9 mils.
- B. Submerged and Severe Service Coating Systems
 - 1. Materials Sources: The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.
 - 2. System No. 3 - Amine-Cured Epoxy: High build, amine-cured, epoxy resin shall have a solids content of at least 80% by volume, and shall be suitable for long-term immersion service in potable water. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.
 - a. Prime coat and finish coats (3 or more, DFT = 16 miles), Ameron 395, Tnemec 139, or equal.
 - b. For coating of valves and nonsubmerged equipment, DFT = 12 mils.
 - 3. System No. 4 - Cold-Applied Tape: Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. The system shall consist of a primer layer, inner layer tape (35 mils), and an outer layer tape (35 mils). Total system DFT = 70 mils. Prefabricated tape shall be Type II for fittings and ANSI/AWWA C214 tape for piping.
 - 4. System No. 5 - Polyamide-Cured Epoxy: High build, polyamide epoxy resin shall have a solids content of at least 56% by volume, and shall be suitable for long-term immersion in potable water. For potable water service, the coating material shall be listed by NSF International as in compliance with NSF Standard 61.
 - a. Prime coat and finish coats (3 or more, DFT = 12 mils), Tnemec 20, Ameron 83HS, or equal.
 - 5. System No. 6 - Fusion Bonded Epoxy: The coating material shall be a 100% powder epoxy applied in accordance with the ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the fluidized bed process.

SECTION 09800 – PROTECTIVE COATING

- a. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than three coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer and per AWWA C210.
 - (1) Coating DFT = 16 mils, Scotchkote 134 or 206N, or equal.
 - (2) Total system DFT = 16 mils.
 - (3) For coating of valves, DFT = 12 mils.
6. System No. 7 - Epoxy, Concrete: The coating material shall be an amine-cured epoxy material suitable for long-term immersion in water and for service where subjected to occasional splash and spillage of water treatment chemicals. The finish coating material shall have a minimum solids content of 80% by volume. If used for potable water service the finish coating material shall be listed by the NSF International as in compliance with NSF Standard 61, and shall conform with state and local health regulations and policies for service in potable water. The filler-sealer shall be a 100 percent solids amine-cured epoxy material with silica and inert fillers. A 100 percent solids epoxy surface shall be used to fillholes and patch the concrete surface after abrasive blasting.
 - a. Prime coat (filler-sealer), applied in two coats to the entire surface using a squeegee to achieve a smooth, void-free surface, Thnemec 63-1500, Ameron Nu-Klad 105A followed by Nu-Klad 114A (two coats) or equal.
 - b. Finish coats (2 or more, DFT = 12 mils), Thnemec Series 139 Ameron 395, or equal. On walking surfaces, use a nonskid additive such as Ameron 886 in the final coat.
- C. Special Coating Systems
 1. System No. 8 - Cold-applied petrolatum/wax tape coating materials and procedures shall be in accordance with ANSI/AWWA C217. The system shall consist of a primer (DFT = 3 mils) and a tape layer (40 mils minimum thickness).
 2. System No. 9 - Rich Portland Cement Mortar: Rich Portland cement mortar coating shall have a minimum thickness of 1/8 inch.
 3. System No. 10 - Cement Mortar Coating: Cement mortar coating materials and procedures shall conform to the requirements of ANSI/AWWA C205. A 1-1/4-inch minimum thickness mortar coating

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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.

4. System No. 11 - Tape and Cement Mortar Coating: A flexible pipe dielectric coating system (polyethylene tape) and cement mortar protective overcoat (rock shield) shall be provided. Polyethylene tape requirements shall conform to the requirements of ANSI/AWWA C214. A 3/4-inch minimum thickness mortar coating (rock shield) shall be provided and shall be reinforced with welded wire fabric conforming to the requirements of ANSI/AWWA C205. Cement mortar shall conform to the requirements of ANSI/AWWA C205, and cement for mortar shall be Type V.

5. System No. 13 - UV Stabilized Coating for Exposed PVC Piping: Exterior surfaces of PVC piping exposed to sunlight shall be completely coated with a single component, water-based acrylic latex with a fungicide additive. Exposed PVC piping in interior, nonsubmerged applications shall be color-coded in accordance with Section 15030 - Pipe Identification Systems using a single component, water-based acrylic latex. The acrylic latex shall have a minimum solids content of 35 percent by volume. The prime coat shall be as recommended by the manufacturer. The coating material shall be available in ANSI safety colors. The system shall include a prime coat (DFT = 2 mils) as recommended by the manufacturer. The system shall include two or more finish coats (DFT = 6 mils) of Amerguard 220, Carboline 3300, or equal. The total system DFT = 8 mils.

2.5 COATING SYSTEM SCHEDULE: The CONTRACTOR shall provide protective coatings in accordance with the schedule below. Proposed modifications shall be presented individually in writing to the RESIDENT ENGINEER for consideration during the design phase and upon acceptance by the RESIDENT ENGINEER shall be included in the CONTRACT DOCUMENTS.

Item	Surface Prep.	System No.
All ferrous surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC-SP6	(1) aliphatic polyurethane

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Item	Surface Prep.	System No.
Surfaces of piping and equipment and ferrous surfaces submerged or intermittently submerged in potable water and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC-SP5	(3) amine-cured epoxy
Buried steel pipe 3-inch diameter and smaller.	Removal of dirt, grease, oil	(4) cold applied tape
Where indicated, ferrous surfaces in water passages of all valves 4-inch diameter and larger, exterior surfaces of submerged or buried valves.	White metal blast cleaning SSPC-SP5	(5) polyamide-cured epoxy
Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge diameter of 4 inches or larger.	White metal blast cleaning SSPC-SP5	(3) amine-cured epoxy
Ferrous surfaces of sleeve-couplings and exposed piping inside buildings/vaults.	White metal blast cleaning SSPC-SP5	(6) fusion-bonded epoxy
Buried surfaces that are not indicated to be coated elsewhere.	Removal of dirt, grease, oil	(4) cold applied tape
Above-grade or below-grade concrete, submerged and non-submerged	Per paragraph 3.7	(7) epoxy, concrete
Below-grade concrete, submerged, potable water	Per paragraph 3.7	(7) epoxy, concrete
Galvanized surfaces where indicated	Sweep blast cleaning SSPC-SP7	(2) epoxy
Buried pipe couplings, valves, and flanged joints, including epoxy-coated surfaces	As specified by reference specification	(8) petrolatum/wax tape

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Item	Surface Prep.	System No.
Buried plastic pipe couplings, valves, fittings, and flanged joints (where piping is plastic)	Removal of dirt, grease, oil	(9) rich Portland cement mortar
Buried steel pipe and fittings	As specified by reference specification	(11) tape and cement mortar
Buried ductile or cast iron pipe and fittings	As specified by manufacturer for polyurethane coating; as specified by reference specification for epoxy coatings	(8) petrolatum/wax tape
Exposed PVC piping	Solvent-cleaned SSPC-SP1	13) acrylic latex

PART 3 – EXECUTION

3.1 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on all Work.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. All damage to surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition.

3.2 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations: Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for

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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:

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- 1 Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
- 2 Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
- 3 Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
- 4 White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
- 5 Commercial Blast Cleaning (SSPC-SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
- 6 Brush-Off Blast Cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
- 7 Near-White Blast Cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
- 8 Surface Preparation of Concrete (SSPC-SP13): Concrete surface shall be free of contaminants, laitance, loosely adhering concrete and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

3.5 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these Specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.

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- 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

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removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.

- N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.6 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.7 SURFACE PREPARATION FOR CONCRETE SURFACES

- A. Prepare surfaces of concrete to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, with soap and water.
- B. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests in accordance with SSPC-SP13. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint in accordance with the coating manufacturer's recommendations. Provide suitable testing materials and carry out alkalinity and moisture tests.
- C. Do not paint over surfaces where the moisture content exceeds 8%, unless otherwise permitted in the manufacturer's printed directions.
- D. Surface preparation and acceptance criteria shall be in accordance with methods described in SSPC-SP13, except acid etching and flame cleaning will not be permitted.

3.8 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged or buried in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this Section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touchup painted after installation.
- B. All items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.

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- C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have all surface preparation and coating work performed in the field.
- D. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these Specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.

3.9 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC-PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and all coats shall be inspected before each succeeding coat. Schedule such inspection with the RESIDENT ENGINEER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated before assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
 - 1 Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2 Dust or smoke laden atmosphere.

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- 3 Damp or humid weather.
 - 4 When the substrate or air temperature is less than 5 degrees F above dewpoint.
 - 5 When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
 - 6 When wind conditions are not calm.
- I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables.
 - J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

3.10 CURING OF COATINGS

- A. Maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, before placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.11 SHOP AND FIELD INSPECTION AND TESTING

- A. General: Furnish the RESIDENT ENGINEER 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 RESIDENT ENGINEER, unless the RESIDENT ENGINEER has granted prior approval to perform such Work in its absence.
- C. Inspection by the RESIDENT ENGINEER, 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 RESIDENT ENGINEER. 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

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measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the RESIDENT ENGINEER'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 RESIDENT ENGINEER.

- 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" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On nonferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- 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.

3.12 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing Work. Leave all such work undamaged. Correct all

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damages by cleaning, repairing or replacing, and repainting, as acceptable to the RESIDENT ENGINEER

- B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove all temporary protective wrappings provided for protection of this Contract and other contracts after completion of painting operations.

3.13 CLEAN-UP

- A. During the progress of Work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.
- B. Upon completion of painting Work, clean window glass and all other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. At the completion of Work of other trades, touch up and restore all damaged or defaced painted surfaces as determined by the RESIDENT ENGINEER.

**** END OF SECTION ****

SECTION 09900 - ARCHITECTURAL PAINT FINISHES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes preparation of surfaces and painting of surfaces not intended to receive other protective coatings.
- B. Following are some of the types of surfaces which are not included in the WORK of this Section:
 - 1. Factory-finished surfaces.
 - 2. Surfaces whose coatings are for the specific purpose of protection from abrasion, wear and tear, or from corrosion, oxidation, decomposition, or other effects of exposure.
 - 3. Stainless steel, aluminum brass, bronze, and plated finished metals (not zinc or cadmium).
 - 4. Finish hardware except prime-coated items, and fusible links, UL labels, nameplates, numbers, and identifying data.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 08110 Steel Doors and Frames
 - 3. Section 09800 Protective Coatings
 - 4. Section 15030 Pipe Identification Systems

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. California Building Code

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted for all paint finishes:

SECTION 09900 - ARCHITECTURAL PAINT FINISHES

1. Manufacturer's product data describing paint materials as to composition and manufacturer's recommended usage, preparation and application.
2. List of proposed paint materials with each material identified, manufacturer's name, product name, and number. The list shall include primers, thinners, and coloring agents. The list shall be submitted within 60 days after Notice to Proceed.
3. Color samples and stain samples. Stain samples shall be provided on the same material as the stain will be applied in the final installation.
4. Identification, including finish and color, of surfaces to receive paint materials.

1.5 FIELD TESTING

- A. Thickness of the paint film shall be tested by the RESIDENT ENGINEER in compliance with Section 09800. CONTRACTOR shall furnish the required gages for performing these tests.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers.
- B. Paint materials shall be covered, and precautions shall be taken for the prevention of fire. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.

1.7 QUALIFICATIONS

- A. Paint materials shall be the products of reputable manufacturers, specializing in such products, who have demonstrated successful experience with the indicated coating systems in the recent past.

1.8 WARRANTY INSPECTION

- A. A warranty inspection shall be conducted during the eleventh month following completion of painting WORK. The CONTRACTOR and Installer shall attend this inspection. The RESIDENT ENGINEER may, at his sole option, by written notice to the CONTRACTOR, reschedule the warranty inspection within the contract guarantee period, or may cancel the warranty inspection altogether.

PART 2 - PRODUCTS

2.1 GENERAL

SECTION 09900 - ARCHITECTURAL PAINT FINISHES

A. General: Only paint materials certified as complying with the indicated requirements shall be provided.

B. Products: Paint materials shall be new and of current manufacture.

2.2 ALTERNATIVE MATERIALS

A. Where alternative painting systems are indicated, selection from among the alternatives is the CONTRACTOR's option.

B. Coatings applied under a single paint system shall be the products of a single manufacturer.

2.3 FACTORY MIXING

A. Paint shall be factory-mixed to the specified color, gloss, and consistency indicated.

2.4 PRIMERS AND FINISH PAINTS

A. Primers: Primers, represented by the symbol below for the associated generic group, shall be the product, known by the tradename, of one of the listed manufacturers (or equal):

Generic Group	Manufacturer/Trade Name
Masonry Prime Coat (waterproofing)	Chemstop Heavy Duty Masonry Waterproofing Rainguard Heavy Duty Waterproofing Thompson Heavy Duty Water Seal
Pigmented Wall Primer and Sealer	Pittsburgh Speedhide Primer Sealer SW Wall Primer and Sealer B49W1 Sinclair Pigmented Sealer.
Clear Primer-Sealer	Pittsburgh REZ Clear Primer-Sealer Sinclair Clear Primer-Sealer

B. Finish Paints: Finish paints, represented by the symbol below for the associated generic group, shall be the product, known by the tradename, of one of the listed manufacturers (or equal):

Generic Group	Manufacturer/Trade Name
Semi-Gloss Alkyd Enamel	Pittsburgh Speedhide Semi-Gloss Enamel

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Generic Group	Manufacturer/Trade Name
	SW Promar Alkyd Semi-Gloss Enamel B34 Series Sinclair Sinco Satin Enamel
Exterior Latex Finish	Pittsburgh Speedhide Semi-Gloss Enamel SW Promar Exterior Latex B36 Series Sinclair Plast-O-Life
Gloss Alkyd Enamel	Pittsburgh Speedhide Exterior Wood Finish SW Promar Gloss Alkyd Enamel Sinclair Avalon Gloss

2.5 SCHEDULE OF PRIMERS AND FINISHES

- A. Primers and Finishes: Primers and finishes shall be applied, as indicated, for exterior and interior WORK in compliance with SSPWC Sub-section 310-5 and this Section.
- B. Colors: Colors shall comply with the color selection in the Construction Documents

2.6 EXTRA PAINT MATERIALS

- A. The CONTRACTOR shall furnish 1 extra gallon of each paint material and color used.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Atmospheric Conditions: Painting shall comply with SSPWC Sub-section 310-1.1 except that painting shall not be applied under the following conditions: (1) when the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees F; (2) to wet or damp surfaces or in rain, fog or mist; (3) when the temperature is less than 5 degrees F above the dewpoint temperatures; (4) when it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dewpoint within 8 hours after application of coating; or (5) in extreme heat or in dust- or smoke-laden air. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.
- B. Workmanship: Except as otherwise indicated, paint materials shall be applied by brush or roller and in accordance with the manufacturer's instructions. Each coat shall be applied at proper consistency, and shall be free of brush or

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roller marks, sags, runs or other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces is not permitted. Masking tape shall be applied. Surfaces shall be sanded between enamel coats.

- C. Coverage Rates: In no case shall paint application exceed the paint manufacturer's published coverage rate based upon unthinned material. In the event that paint has been extended beyond the recommended coverage, or the "hide" produced is inadequate, additional coats shall be applied. The manufacturer's recommended amount of thinner shall not be exceeded. Finish paint material shall be applied directly from manufacturer's container.
- D. Protection: Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers and drop cloths.
- E. Removal of Finish Hardware: Finish hardware shall be removed prior to painting and re-installed.
- F. Contrasting Colors: Where painting is to be executed in contrasting colors, edges shall be cut to meet true lines. Holidays and restrikes in painted surfaces shall be sufficient cause for recoating the entire surface involved.
- G. Barricades: Barricades and wet paint signs shall be maintained for duration of painting.
- H. Scaffolds: Scaffolds, staging, and planking shall be used wherever required for proper painting.

3.2 SURFACE PREPARATION

- A. Ferrous and Galvanized Metal: Ferrous metal surfaces shall be prepared in compliance with SSPWC Sub-sections 310-2 and 310-3. Surfaces shall be cleaned of rust, scale, grease, oil, and other deleterious matter by wire brushing, scraping, washing with solvent, sandblasting, and other means necessary to prepare surfaces properly for painting. Shop painted ferrous metal surfaces that show rusting when initially installed shall be touched up with a rust inhibitor complying with the requirements of MIL-M-10578B for Phosphoric Acid Rust Inhibitor. Rust inhibitor shall be applied only after wire brushing to a sound surface, and the surface shall be prime coated. Galvanized metals shall be cleaned with suitable organic solvent. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work.
- B. Masonry and Concrete: Masonry and concrete shall be dry and free of dust, dirt, grease, oil, and other foreign matter such as loose or granular material. Holes, cracks, joints and other surface defects shall be repaired and filled out flush and smooth with appropriate products, except where a priming coat is recommended by the manufacturer of the paint. Glaze and loose particles

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shall be removed by wire brushing. No evidence of curing compounds, release agents and the like will be acceptable.

3.3 APPLICATION

- A. Paint shall be applied in accordance with manufacturer's printed instructions.
- B. Spray painting, where allowed, shall be conducted under controlled conditions, and the CONTRACTOR shall be responsible for damage to adjacent work or adjoining property resulting from spray painting.
- C. Drying times shall not be less than those in manufacturer's printed instructions.
- D. Surfaces found to contain runs, overspray, roughness, or other signs of improper application shall be recoated.
- E. Woodwork shall be sanded smooth and knots and pitch streaks shall be painted with a thick coat of orange shellac or a resin sealer, except for stained wood. Nail holes and minor imperfections shall be filled between first and second coat; color of fill material shall match stain in the case of stained work.
- F. Back surfaces of wood trim and finish that will be concealed after installation, including exposed grounds, and paneling shall be painted prior to installation; the primer indicated for exposed surfaces shall be applied. WORK to receive a natural finish shall be backpainted with one coat of spar varnish. Backpainting shall be omitted on factory finished casework and cabinets.
- G. The number of coats indicated to be applied are minimums. Paint finishes shall be even, of uniform color, and shall be free from cloudy or mottled appearance in surfaces and evident thinness of coatings. Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.4 REQUIREMENTS OF PAINTING AND FINISHING WORK

- A. Exterior: Exposed exterior surfaces of the building shall be painted and finished in accordance with the indicated requirements. Exposed surfaces of metal, sheet metal, mechanical equipment, and other, as required, shall be painted with the indicated primers and finish of paint.
- B. Interior: Exposed interior surfaces of the building shall be painted and finished in accordance with the indicated requirements and as follows:
 - 1. Exposed surfaces of gypsum wallboard, plaster, and doors and frames, shall be primed and painted as indicated.

SECTION 09900 - ARCHITECTURAL PAINT FINISHES

2. Metal surfaces in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area except as otherwise indicated.
 3. Painted doors opening into rooms or spaces with different finishes or colors shall be edge-finished as directed. Closet and storage room doors shall be finished on both sides to match the room into which they open.
- C. Mechanical and Electrical Work: Mechanical and electrical products requiring painting shall conform to the requirements of Section 09800 except for the following:
1. Areas behind grilles, baffles, ventilators, and louvers: exposed surfaces, not factory finished, visible from inside and outside of the building shall be painted with appropriate primers and one coat of black semi-gloss (low sheen) enamel paint far enough to conceal such areas and spaces when looking towards them from the floor and ground levels.
 2. Pipe Identification: Piping shall be identified according to the requirements of Section 15030.

3.5 INSPECTION AND CLEANING

- A. General: The WORK of this Section includes inspection of finishes after painting WORK has been completed. Splatterings of paint materials on adjoining WORK including plumbing fixtures, trim, tile, and finish metal surfaces is not allowed. Abraded, stained, or otherwise disfigured painting WORK shall be touched-up.
- B. Upon completion of the work, staging, scaffolding and containers shall be removed from the site. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. Damage to adjacent surfaces or facilities resulting from the WORK performed under this Section shall be cleaned, repaired or refinished.

**** END OF SECTION ****

SECTION 10200 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum and formed-metal louvers.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 04232 Reinforced Concrete Block Masonry
3. Section 09800 Protective Coatings

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
2. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft. acting inward or outward.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.4 SUBMITTALS

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

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

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- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 4 finish.
- E. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 3. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 4. For color-finished louvers, use fasteners with heads that match color of louvers.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

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- B. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following or equal:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. American Warming and Ventilating, Inc.; a Mestek company.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Cesco Products; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Metal Form Manufacturing Inc.
 - l. NCA Manufacturing, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 - o. Vent Products Company, Inc.
2. Louver Depth: 6 inches.
3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch for frames and 0.040 inch for blades.
4. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than 0.050 inch.

SECTION 10200 - LOUVERS AND VENTS

5. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft for 48-inch- wide by 48-inch-high louver.
 - b. Point of Beginning Water Penetration: Not less than 800 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area velocity.
 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- B. Horizontal, Nondrainable-Blade Louver
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following or equal:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. American Warming and Ventilating, Inc.; a Mestek company.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Cesco Products; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Metal Form Manufacturing Inc.
 - l. NCA Manufacturing, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 - o. Vent Products Company, Inc.
 2. Louver Depth: 6 inches.
 3. Blade Profile: plain blade without center baffle.

SECTION 10200 - LOUVERS AND VENTS

4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch for frames and 0.040 inch for blades.
5. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than 0.050 inch.
6. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft for 48-inch- wide by 48-inch-high louver.
 - b. Point of Beginning Water Penetration: Not less than 550 fpm.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
- B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.
- C. Louver Screening:
 1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
 2. Bird Screening: Stainless steel, 1/2-inch- square mesh, 0.047-inch wire.
 3. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.
 4. Bird Screening: Galvanized steel, 1/2-inch- square mesh, 0.041-inch wire.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 1. Color: As selected by Owner from manufacturer's full range
- C. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Color and Gloss: As selected by Owner from manufacturer's full range

2.6 GALVANIZED-STEEL SHEET FINISHES

SECTION 10200 - LOUVERS AND VENTS

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- C. 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 film thickness of 1 mil for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: As selected by Owner from manufacturer's full range.

2.7 STAINLESS-STEEL SHEET FINISHES

- A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
- E. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

***** END OF SECTION *****

SECTION 10520 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing fire protection equipment, cabinets, and appurtenant work, complete.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals

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. Uniform Fire Code

1.4 SPECIFICATIONS AND STANDARDS

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

- 1. Trade Standards:

National 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

- A. Delivery of Materials: Fire extinguishers and appurtenant materials shall be delivered in original unbroken packages or containers, bearing the manufacturer's label with manufacturer's name, product description, and rating.

SECTION 10520 - FIRE EXTINGUISHERS

- B. Storage: All materials shall be carefully stored in an area which is protected from deleterious elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All fire protection equipment shall be from the same manufacturer [unless otherwise indicated] and shall meet the requirements of NFPA Standard No. 10, "Portable Fire Extinguishers"

2.2 FIRE EXTINGUISHERS

- A. Type A extinguisher shall be 20 lb minimum capacity, dry chemical type with minimum UL rating of 10-A:60-B:C, in enameled steel container, for Class A, Class B, and Class C fires.
- B. Type B extinguisher shall be 10 lb minimum capacity, dry chemical type with minimum UL rating of 4-A:60-B:C, in enameled steel container, for Class A, Class B, and Class C fires.
- C. Type C extinguisher shall be 14 lb minimum capacity, 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 CABINETS

- A. Fire extinguisher cabinet shall be semi-recessed steel cabinet with clear, anodized aluminum door and door frame, and projecting, convex, butyrate plastic, canopy type viewing door panel. The size shall be as necessary to hold fire extinguisher at cabinet location.

2.4 BRACKETS AND OTHER MATERIALS

- A. Mounting brackets shall be specially designed for extinguishers or cabinets.
- B. All other materials, not specifically described, but required for a complete and proper installation of fire fighting devices shall be as selected by the CONTRACTOR.

2.5 MANUFACTURERS

- A. Fire protection equipment shall be manufactured by one of the following (or equal):
 1. General Fire Extinguisher Corp.

SECTION 10520 - FIRE EXTINGUISHERS

2. J.L. Industries
3. Potter-Roemer
4. Standard Fire Equipment (Division of Zurn Co.)
5. Walter Kidde and Co.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Brackets: All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The CONTRACTOR shall block and reinforce the wall area as necessary to support the fire extinguishers.
- B. Locations: Fire protection equipment locations shall be verified with the RESIDENT ENGINEER 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 the CONTRACT DOCUMENTS.
- B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise indicated.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 05500 Miscellaneous Metals
- 3. Section 09800 Protective Coating
- 4. Section 11175 Pumps, General
- 5. Section 13334 Pressure Measuring Systems
- 6. Section 15000 Piping Components
- 7. Section 15020 Pipe Supports
- 8. Section 16040 Electric Motors
- 9. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as indicated in each Section:

- 1. American Society for Testing and Materials (ASTM)
- 2. American Public Health Association (APHA)
- 3. American National Standards Institute (ANSI)
- 4. American Society of Mechanical Engineers (ASME)
- 5. American Water Works Association (AWWA)
- 6. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
- 7. American Welding Society (AWS)
- 8. American Gear Manufacturers Association (AGMA)
- 9. American Iron and Steel Institute (AISI)
- 10. National Fire Protection Association (NFPA)
- 11. Federal Specifications (FS)

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12. National Electrical Manufacturers Association (NEMA)
13. Antifriction Bearing Manufacturers Association (AFBMA)
14. Mechanical Power Transmission Association (MPTA)
15. Rubber Manufacturers Association (RMA)
16. Sheet Metal and Air Conditioning CONTRACTOR'S National Association (SMACNA)
17. Hydraulic Institute Standards (HYI)
18. Institute of Electrical and Electronic Engineers (IEEE)
19. Instrument Society of America (ISA)
20. Manufacturer's published recommendations and specifications
21. General Industry Safety Orders (CAL OSHA)

B. The following standards have been referred to in this Section:

1. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
2. ANSI B16.5 Pipe Flanges and Flanged Fittings, NPS 2 through NPS 24
3. ANSI B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)
4. ANSI S12.6 Methods for Measuring the Real-Ear Attenuation of Hearing Protectors
5. ANSI/ASME B1.20.1 General Purpose Pipe Threads (Inch)
6. ANSI/ASME B31.1 Power Piping
7. ANSI/AWWA D100 Welded Steel Tanks for Water Storage
8. AWWA C206 Field Welding of Steel Water Pipe
9. ASTM A 48 Specification for Gray Iron Castings
10. ASTM A 108 Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality

1.4 CODES

A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. California Mechanical Code
2. California Plumbing Code
3. California Fire Code

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

4. National Electrical Code
5. California Building Code

1.5 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall furnish complete shop drawings for all equipment specified in other Sections, together with all materials, fabrication, assembly, foundation, and installation drawings in accordance with Section 01300 - Submittals.
- B. Tools: The CONTRACTOR shall obtain from the manufacturer a list of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. All tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal. After approval, CONTRACTOR shall furnish such tools neatly mounted in a labeled tool box of suitable design provided with a hinged cover.
- C. Spare Parts: In accordance with Section 01750 - Spare Parts and Maintenance Materials, the CONTRACTOR shall obtain from the manufacturer and submit to the RESIDENT ENGINEER a list of suggested spare parts for each piece of equipment. After approval, the CONTRACTOR shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the OWNER, only, after expiration of the correction period.
- D. Operation and Maintenance Information: The CONTRACTOR shall submit operations and maintenance information for each piece of equipment. The following shall be included in compliance with Section 01300 - Submittals:
 1. Manufacturer's catalog including installation instructions.
 2. Manufacturer's operating and maintenance procedures including lubricating instructions.
 3. Manufacturer's certification that products comply with the indicated requirements.
 4. Certification that products have been factory-tested.
 5. Certification that the equipment has been field-tested and the equipment complies with the indicated requirements.
 6. Equipment tolerances and required clearances.

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7. Electrical data including control and wiring diagrams.
 8. Warranty information, address and telephone number of local service representative.
- E. Torsional Analysis: The CONTRACTOR shall submit to the RESIDENT ENGINEER a torsional and lateral vibration analysis of the following equipment, in accordance with Section 01300 - Submittals. The analysis has to be performed by a State of California Registered Professional Mechanical Engineer experienced in this type of Work and approved by the RESIDENT ENGINEER.
1. All engine drives.
 2. All blowers and compressors with drives of 100 horsepower and over.
 3. All synchronous motor driven trains.
 4. All electric motor with variable frequency drive (VFD) trains.
 5. All other equipment where indicated.

Excitation of the following frequencies shall be evaluated:

1. Train with gear 1 and 2 x RPM of either shaft
2. Engine drive n x RPM
3. Synchronous motor n x slip frequency, 1 and 2 x line frequency
4. VFD n x RPM, 1 and 2 line frequency

where:

RPM = Rotor speed

N = an integer determined by the drive manufacturer

- for engines: derived from the number of power strokes per revolution

- for motors: derived from the number of poles

Note: The excitation frequencies for motor drives shall include transient and steady state conditions.

- F. The undamped torsional natural frequencies of the complete train shall be at least 10 percent above or 10 percent below any possible (steady state) excitation frequency within the specified operating speed range (from minimum to maximum continuous speed). The manufacturer shall furnish a detailed report of the analysis including the following:
1. A description of the method used to calculate the natural frequencies.
 2. A diagram of the mass elastic system.

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3. A table of the mass moment and torsional stiffness of each element of the mass elastic system.
 4. A Campbell diagram.
 5. A mode shape diagram with peak stresses shown for each resonant frequency.
- G. Vibration Analysis: In his bid price the CONTRACTOR shall include at least two site visits of the above-mentioned specialist, during construction and testing of the equipment, to analyze and measure the amount of equipment vibration and make his written recommendation for keeping the vibration at a safe limit.
- H. Earthquake Design and Restraint. All manufactured equipment supplied under this contract shall be designed, constructed and attached to resist stresses produced by seismic forces specified in this Section. Equipment that does not vibrate during normal operation shall be rigidly attached. Equipment that vibrates during normal operation shall be attached by means of isolators with mechanical stops that limit movement in all directions, unless it can be demonstrated by calculations that such stops are not required. Equipment or portions of equipment that move during normal operation shall be restrained with mechanical devices that prevent displacement unless it can be demonstrated by calculations that such restraints are not required.
1. Work Included. The requirements specified in this Article apply to all machinery, mechanical and electrical equipment, instrumentation panels, and electrical panels, including but not limited to:
 - a. All pumps.
 - b. All compressors.
 - c. All tanks.
 - d. Engine generators.
 - e. Heat exchangers.
 - f. Water treatment systems
 - g. HVAC equipment.
 - h. Engine cooling equipment.
 - i. All electrical equipment and panels, including battery racks
 - j. All instrumentation panels.
 2. Minimum Earthquake Forces. Except as provided herein, the minimum design earthquake forces shall be those prescribed for Essential Facilities by the 1994 edition of the Uniform Building Code as published by the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California, 90601.
 3. Submit shop drawings, details and data required in this Section.

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4. Installation Certificate Report in accordance with Subsection 11100-3.8B.

1.6 QUALITY ASSURANCE

- A. Inspection, Startup, and Field Adjustment: The CONTRACTOR shall demonstrate that all equipment meets the specified performance requirements. CONTRACTOR shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site to perform the following tasks:
 1. Assist the CONTRACTOR in the installation of the equipment.
 2. To inspect, check, adjust if necessary and approve the equipment installation.
 3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.
 4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the RESIDENT ENGINEER.
 5. To instruct the OWNER's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. Costs: The costs of all inspection, startup, testing, adjustment, and instruction Work performed by said factory-trained representatives shall be borne by the CONTRACTOR. The OWNER will pay for costs of power and water. When available, the OWNER'S operating personnel will provide assistance in the field testing.
- C. Public Inspection: It shall be the responsibility of the CONTRACTOR to inform the local authorities, such as building and plumbing inspectors, Fire Marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, and safety systems to obtain all required permits and certificates, and pay all fees.
- D. Tolerances: Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine Work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30 feet or less in length, and not greater than 1/8-inch for members over 30 feet in length.

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- E. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:
1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.
 2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
 3. Surface roughness not greater than 500 micro-inches shall be required for other machined surfaces.
 4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.
- F. Manufacturer's Experience: Unless otherwise directed by the RESIDENT ENGINEER, all equipment furnished shall have a record of at least 5 years of successful, trouble free operation in similar applications, from the same manufacturer.
- G. Warranty: Unless otherwise specified, all equipment shall have a minimum of one year full parts and service warranty.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. General: Only products meeting the indicated requirements shall be provided.
- B. Manufacturers: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. Products: Materials shall be suitable for the intended purpose and free of defects and shall be recommended by the manufacturer for the application indicated.
- D. High Noise Level Locations: The CONTRACTOR shall provide one personal hearing protection station, as indicated herein, at each high noise level location. Said locations are defined as follows:
1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2-hour exposure. Where such equipment is

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

separated by a distance of more than 20-feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.

2. Indoor Location:
 - a. Any single equipment item, or any group of equipment items, located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.
 - b. Any single equipment item, or any group of equipment items, located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.

3. Personal Hearing Protection Station: At each station, the CONTRACTOR shall supply, in their original unopened packaging, three pairs of high attenuation hearing protectors. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25-dBA at a frequency of 500-Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the CONTRACTOR and mounted in an approved location near the noise protection station.

E. Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Unless otherwise calculated, the minimum service factor shall be 1.25. Unless otherwise indicated, the following load classifications shall apply in calculating service factors:

Type of Equipment	Load Classification
Blower:	
Centrifugal or vane	Uniform
Lobe	Moderate Shock
Reciprocating Air Compressor:	
Multi-Cylinder	Moderate Shock
Single-Cylinder	Heavy Shock
Pump:	
Centrifugal or Rotary	Uniform
Reciprocating	Moderate Shock
Mixer:	

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Constant Density	Uniform
Variable Density	Moderate Shock
Fan/Blower	Moderate Shock

- F. For service factors of electric motors, see Section 16040 - Electric Motors. Where load classifications are not indicated, best modern practice shall be used.
- G. Welding: Unless otherwise indicated, all welding shall conform to the following:
1. Latest revision of ANSI/AWWA D100.
 2. Latest revision of AWWA C206.
 3. All composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
 4. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
 5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- H. Protective Coating: All equipment shall be painted or coated in accordance with Section 09800 - Protective Coating, unless otherwise indicated. Nonferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- I. Protection of Equipment: All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Fans, blowers, pumps, motors, drives,

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electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities before installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings.

- J. Identification of Equipment Items: Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number indicated for the particular item.
- K. Vibration Level: All reciprocating equipment shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations.
- L. Shop Fabrication: Shop fabrication shall be performed in accordance with the CONTRACT DOCUMENTS and the approved shop drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Equipment Supports: All equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports must bear the signature and seal of an engineer registered in California.
- B. Provide a heavy cast-iron or welded steel base shall be provided for each item of equipment which is to be installed on a concrete foundation.
 - 1. Mount equipment assemblies, unless otherwise specified, or shown on the Drawings on a single, heavy-cast-iron or welded steel bedplate.
 - 2. Provide bases and bedplates with machined support pads, tapered dowels for alignment of mating, or adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.
 - 3. All seams and contact edges between steel plates and shapes shall be continuously welded and ground smooth.
 - 4. The plates shall have a minimum thickness of 3-inch.
 - 5. Include a drip lip and provision for directing accumulated gland leakage to a single disposal drain point.
- C. Pipe all accumulated gland and seal water leakage and spent cooling water to a floor drain provided by CONTRACTOR adjacent to each piece of equipment.

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1. A single floor drain may be provided for more than one piece of equipment provided the equipment drain line does not create a safety or tripping hazard.
 2. If drain piping creates a hazard, provide an additional floor drain adjacent to the equipment at no additional cost to the OWNER.
- D. Equipment Foundations: Equipment foundations shall be as per manufacturer's written recommendations. All mechanical equipment, tanks, and control cabinets shall be mounted on concrete bases as shown on standard structural details.
- E. Shop Drawings: Shop drawings shall be submitted to the RESIDENT ENGINEER for review in accordance with the requirements of Section 01300 - Submittals. Shop drawings will be considered incomplete unless clear, concise calculations are presented showing equipment anchorage forces and the capacities of the anchorage elements provided by the CONTRACTOR.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with the requirements of Section 15020 - Pipe Supports.

2.4 FLANGES AND PIPE THREADS

- A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with requirements of Section 15000 - Piping Components.

2.5 BOLTS AND FASTENERS FOR PIPING

- A. Bolts and pipe fasteners for exposed ferrous piping shall conform with Section 15000 - Piping Components.

2.6 FLEXIBLE COUPLINGS

- A. Flexible element couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts driven by solid shaft drivers, the coupling shall be a spacer type. The spacer shall be of sufficient length to permit seal replacement without removal of the driver.

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- B. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. Couplings shall be keyed to the shaft. Keys, keyways, and fits shall conform to ISO/R773. Flexible couplings with cylindrical bores shall have interference fits as specified in ISO/R286. Coupling hubs shall be furnished with tapped puller holes.
- D. Where universal type couplings are specified, they shall be of the needle bearing type construction, equipped with commercial type grease fittings.
- E. Jacking Screws and Anchor Bolts
 - 1. Provide jacking screws in the equipment bases and bedplates to aid in leveling before grouting.
 - 2. Equipment suppliers shall furnish anchor bolts, nuts, washers and sleeves of adequate design as required for proper anchorage of the bases and bedplates to the concrete bases.
 - a. Sleeves shall be a minimum of 12 times the diameter of the anchor bolts.
 - b. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-inch of grout beneath the baseplate and to provide adequate anchorage into structural concrete.
 - c. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.
 - d. Anchor bolts shall be 316 stainless steel for all equipment except for pumps which will be Type 416 stainless steel which conform to ASTM A167 and ASTM A276.

2.7 ELECTRIC MOTOR DRIVES

- A. All electric motors supplied under this Contract shall conform to all requirements specified in Section 16460 - Electric Motors. Additional or superseding requisites for certain motors may be found in Divisions 11, 14, 15, and 16 wherein electric motor driven equipment is specified.
- B. CONTRACTOR must coordinate the work of all trades and the national safety code requirements for each installation in order to comply with these specifications.

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2.8 GEARS AND GEAR DRIVES

- A. Unless otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours and a minimum efficiency of 94 percent. Worm gears shall not be used unless specifically approved by the RESIDENT ENGINEER.
- B. All gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, arranged for easy reading.
- C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
- D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have two positive seals to prevent oil leakage.
- E. Oil level indicators and drain shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be furnished when necessary.
- F. Where gear drive input or output shafts have to connect to couplings or sprockets supplied by others, the CONTRACTOR shall have the gear drive manufacturer supply matching key taped to the shaft for shipment.

2.9 FLEXIBLE CONNECTORS

- A. General: Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with Section 15000 - Piping Components.

2.10 INSULATING CONNECTIONS

- A. General: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 15000 - Piping Components.

2.11 GASKETS AND PACKINGS

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- A. Gaskets shall be in accordance with the requirements of Section 15000 - Piping Components. Gaskets containing asbestos will not be permitted.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the RESIDENT ENGINEER, in accordance with Section 11175 - Pumps, General.

2.12 NAMEPLATES

- A. Equipment nameplates of Type 316 stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head Type 316 stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.13 SAFETY REQUIREMENTS

- A. Where Work areas are located within a flammable or toxic gas environment, suitable gas detection, ventilating, and oxygen deficiency equipment shall be provided. Workers shall be equipped with approved breathing apparatus.

2.14 OVERLOAD PROTECTION

- A. General: Unless otherwise indicated in individual equipment Sections, all equipment drives incorporating overload protection shall be provided with an overload protection device as follows:
 - 1. Mechanical System: The overload protection shall be a mechanical device to provide for reliable protection in the event of excessive overload. It shall be a ball detent type designed for long term repeatability and life. It shall be infinitely adjustable by a single adjusting nut. Once set it shall be tamperproof, and incorporate a torque monitoring and control system. It shall activate an alarm set for 85 percent, and a motor cutout switch set for 100 percent of maximum continuous running torque. A visual torque indication shall be provided and oriented so that it may be read from the walkway. The dial shall be calibrated from 0 to 100 percent of maximum continuous running torque. The design of the torque limiter should initiate the mechanical disengagement of the drive upon overload. Each unit shall be suitable for outdoor/corrosive

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

environments with a protective finish, corrosion inhibiting lubricants and a Type 316 stainless steel cover.

2. Electronic System: As an alternative to the mechanical system, the overload protection may be an Electronic Torque Monitoring Control System capable of displaying torque, rpm's, one level of overload, and two levels of overload of the drive system. It shall incorporate a time-delay for start-up and a voltage monitoring and compensation circuit for up to ± 15 percent variation.

The overload device shall be housed in an enclosure with NEMA rating in accordance with the area designations of Section 16050-Basic Electrical Materials and Methods. A visual torque dial shall be provided and oriented so that it can be easily read from the walkway.

The torque monitoring system shall be calibrated to: alarm and shut down the system in the event the torque drops to 50 percent of normal running; alarm at 85 percent of maximum continuous running torque and shut down the motor at maximum continuous running torque of the equipment. The system shall be calibrated at the factory of the equipment manufacturer and it shall be capable of monitoring twice the maximum continuous running torque of the equipment.

- B. Manufacturers, or equal:
 1. American Autogard Corporation;
 2. Ferguson Enterprises, Inc.

PART 3 -- EXECUTION

3.1 PROTECTION

- A. Box, crated, or otherwise completely enclosed and protected during shipment, handling and storage in accordance with the manufacturer's recommendations.
 1. Protect equipment from exposure to the elements. Keep thoroughly dry and clean at all times.
 2. Store pumps, blowers, motors, electrical equipment, and other equipment having anti-friction or sleeve bearings in weathertight storage facilities such as warehouses. Turn shafts during storage as recommended by the manufacturer to prevent bearing set.

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

3. Clean and restore all materials and equipment showing evidence of rust, dirt contamination, or other surface or subsurface deterioration to the Engineer's satisfaction before installation.
- B. Protect painted surfaces against impact, abrasion, discoloration, and other damage.
 1. Repaint and repair damaged surfaces to the satisfaction of the RESIDENT ENGINEER before acceptance in accordance with the requirements of Section 09800 - Protective Coating.
- C. Protect electrical equipment, controls, and insulation against moisture or water damage.
- D. The CONTRACTOR shall maintain equipment storage facilities in accordance with the provisions of Section 01600 - Materials and Equipment.
- E. Store all equipment in the designated storage facilities from delivery until installation.
- F. Periodically exercise all mechanical equipment, whether in the CONTRACTOR's designated storage facility before final installation, or whether installed, but not yet placed into service or accepted by the RESIDENT ENGINEER, in accordance with procedures prescribed by each manufacturer.

3.2 EQUIPMENT INSTALLATION

- A. Install all equipment in full accordance with the equipment manufacturer's recommendations and good practice.
 1. Where specified in other sections of this specification, factory-trained service personnel shall be on-site to supervise the installation.
 2. Sufficient notice shall be given to the Engineer before equipment installation in order that the Engineer or his representative may be present during installation.
- B. General installation requirements:
 1. Examine equipment for damage in shipping and handling. The examination shall include checking for corrosion, poor workmanship, dirt or deleterious substances, and poor fits.
 2. Level the base plate or bedplate.
 3. Install equipment.

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4. Check alignment of couplings.
5. If grout has been used, check alignment and levelness after the grout has set.
6. Check direction of rotation and correct, if necessary, to insure proper operation.
7. Provide drain lines from all equipment gland leakage housings, seal water openings, spent cooling water outlets, and strainers to nearest floor drain or point of disposal. Blow-down valves shall be provided on all strainers whether or not shown on the drawings.
8. Ensure that all submerged or intermittently submerged powered equipment does not have power and control cable splices of any kind inside wells or pits.
9. Include oil and grease for equipment lubrication in initial operation.

3.3 PLACING EQUIPMENT IN OPERATION

- A. Before being placed in operation, equipment shall be inspected by the manufacturer's factory-trained personnel.
 1. Correct all defects discovered during this inspection before initial equipment start-up.
 2. Remove internal coatings applied at the factory if required.
 3. Lubricate equipment per manufacturer's recommendations and ensure operating levels are correct.
- B. Conduct full-load operations test in the presence of the RESIDENT ENGINEER and the results of such tests shall be recorded.
 1. Unsatisfactory performance shall be corrected and tests shall be repeated until the equipment performance meets the Specifications.
 2. The CONTRACTOR shall furnish all power, materials, services, test equipment and labor required to successfully complete all full load equipment testing specified.
 3. The CONTRACTOR shall certify in writing to the RESIDENT ENGINEER, in triplicate, that all tests were conducted in accordance with these Specifications and that all components within each system successfully function as required.

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

- C. The CONTRACTOR shall notify the RESIDENT ENGINEER 10 calendar days in advance of the time when the equipment will be placed into operation.
- D. During the course of initial operation, the CONTRACTOR shall instruct the OWNER's personnel in the proper operation and maintenance of the equipment, as specified herein.

3.4 COUPLINGS

- A. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations.

3.5 INSULATING CONNECTIONS

- A. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

3.6 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. Hangers, supports, seismic bracing and guides shall be spaced in accordance with ANSI/ASME B.31.1 standard, and with tables in Section 15020 - Pipe Supports.

3.7 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate with subcontractors all necessary space and structural requirements, clearances, utility connections, signals, and outputs.

3.8 INSTALLATION CHECK

- A. Provide an experienced, competent, and authorized representative of the manufacturer or supplier of each major item of equipment, as specified in Divisions 11, 13 14 15 and 16 of these specifications, to check adjust if necessary, and approve the equipment installation.
 - 1. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation.
 - 2. The CONTRACTOR shall have the equipment supplier's representative revisit the job site as often as necessary until all problems are corrected and the equipment installation and operation is satisfactory to the RESIDENT ENGINEER.

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

- B. Each equipment supplier's representative shall furnish through the CONTRACTOR, a written report certifying that the equipment:
1. has been properly installed and lubricated;
 2. is in accurate alignment;
 3. is free from all stress imposed by connecting piping or anchor bolts;
 4. has been operated successfully under full load conditions for a 24-hour period without interruption; and
 5. is ready for continuous operation under specified conditions.
- C. Equipment manufacturers shall furnish the services of competent, factory-trained personnel during the warranty period specified to inspect, service, and repair the equipment where required.
1. Service requests shall be answered and acted upon promptly.
 2. This requirement shall not include normal maintenance and service of equipment, which will be the responsibility of the OWNER.
- D. All costs for this work shall be included in the price bid by the CONTRACTOR.

**** END OF SECTION ****

SECTION 11033 – VARIABLE FREQUENCY DRIVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pulse width modulated (PWM) variable frequency drive (VFD) units with motor, controls, and accessories.
- B. The Work requires that one RESIDENT ENGINEER-approved manufacturer be given responsibility for furnishing the indicated Work but without altering the CONTRACTOR's responsibilities under the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operations and Maintenance Information
 - 3. Section 13300 Instrumentation and Control
 - 4. Section 16040 Electric Motors
 - 5. Section 16050 Basic Electrical Materials and Methods
 - 6. Section 16431 Electrical Systems Analysis
 - 7. Section 16950 Electrical Tests

1.3 CODES

- A. The Work of this Section shall comply with the current edition of NFPA 70, National Electrical Code (NEC), as adopted by the City of San Diego.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current edition of IEEE Standard 519, Guide for Harmonic Control and Reactive Compensation of Static Power Converters, applies to the Work of this Section:

1.5 CONTRACTOR SUBMITTALS

- A. General: The CONTRACTOR shall furnish submittals in accordance with Section 01300 -Submittals, except that shop drawing information for the drives shall be submitted as part of the drawing information for the driven equipment.
- B. Shop Drawings: Shop drawings shall include the following information:

SECTION 11033 – VARIABLE FREQUENCY DRIVES

1. The VFD manufacturer's qualification information noted in Section 2.1 shall be provided.
 1. The manufacturer's qualifications, which shall be in the format of a list of at least three projects successfully completed in which the VFD manufacturer performed system engineering, including harmonic filter calculations, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training. In addition, the list shall include the following information for each project: name of plant, owner, contact name, and telephone number.
 2. Equipment Information:
 - a. Name of drive manufacturer.
 - b. Type and model.
 - c. Assembly drawing and nomenclature.
 - d. Maximum heat dissipation capacity in Kw.
 3. Written description of ladder diagram operation, system operation, and analog signal processing.
 4. Calculation of VFD/motor efficiencies at 50, 75, and 100% speed. The system efficiency shall include power losses from the cooling system, controls, contactors, isolation transformers (if required), line reactors, and harmonic filters.
 5. System block diagram, system schematic diagram, and interconnection diagrams
 6. Enclosure outline and seismic support calculations stamped and signed by a Structural Engineer registered in California.
 7. Factory test data certifying compliance with requirements of similar equipment from the same manufacturer.
 8. Justification for any proposed exception taken to the requirements of this Section. Exceptions shall be in bold letters and be underlined.
- C. The CONTRACTOR shall submit the following documentation in accordance with Section 01730 - Operations and Maintenance Information:
 1. Manufacturer's 1-year warranty.

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2. Harmonic analysis report.

D. Spare Parts List: The CONTRACTOR shall submit the list of spare parts recommended by the drive manufacturer.

1.6 SERVICES OF MANUFACTURER

A. Inspection, Startup and Field Adjustment: An authorized service representative of the manufacturer shall visit the site for not less than 2 days per drive system to perform the following services:

1. Verify proper installation of the equipment.
2. Inspection, checking and adjusting the equipment.
3. Startup and field testing of the VFD controller.

B. Instruction of OWNER's Personnel: The authorized service representative shall instruct the OWNER's personnel in all aspects of drive operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction shall be provided for a maximum of 6 personnel for 3 days.

PART 2 -- PRODUCTS

2.1 QUALIFICATION FOR VFD MANUFACTURERS

A. Manufacturer's Qualifications: The manufacturer shall have successfully completed at least three projects of comparable size and complexity for which the manufacturer performed system engineering, including harmonic filter calculations, system fabrication and installation, documentation (including schematic, wiring, and panel assembly drawings), field testing, calibration, and startup, operator instruction, and maintenance training.

Documentation to be submitted by the Manufacturer:

1. A list of at least three PWM variable frequency drive installation of this type, voltage and similar horsepower operating successfully. The VFD manufacturer shall have performed engineering, including harmonic filter and power factor correction calculations, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training. In addition, the list shall include the following information for each project:
 - a. Name of facility, owner, contact name, and telephone number.
 - b. Name and type of drive equipment, including horsepower, voltage, speed range, and application.

SECTION 11033 – VARIABLE FREQUENCY DRIVES

- c. Drive system furnished (12-step etc).
 2. The names and qualifications of manufacturer's representatives who will be responsible for the following:
 - a. Office engineering.
 - b. Project management.
 - c. Field testing, calibration, startup.
 - d. Operator training.
 3. A letter certifying that the manufacturer's representatives have read and studied the CONTRACT DOCUMENTS and agreed to the requirements of this Section.
- B. Product: Toshiba A51, or approved equal
- 2.3 BOOSTER PUMP VFD
- A. General:
1. Number of drive units – 2.
 2. Driven equipment – P-01 and P-02.
 3. Driven equipment specification --Section 11214, Vertical Turbine Pumps
 4. Drive voltage - 460 V.
- B. Service Conditions: The VFD shall be designed and constructed to operate within the following service conditions:
1. Elevation: <720 feet.
 2. Ambient Temperature Range: -33 degrees F to 95 degrees F.
 3. Atmosphere: Non-condensing, relative humidity to 95 percent.
 4. AC Line Voltage Variation: -5 percent to +10 percent.
 5. AC Line Frequency Variation: ± 3 Hz.
- C. Operating Conditions: -to 3300 feet -32 to 104 degrees F -Noncondensing relative humidity to 95% --5% to +10% -+ 3 Hz
1. Minimum VFD efficiency shall be 95% at 100% speed and 100% torque and 87% at 60% speed based on nominal 1800 RPM motor with load horsepower to vary as cube of speed.

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2. Distribution voltage shall be 480 V, three phase, three wire, 60 Hz as indicated.
3. Total harmonic voltage and current distortion with filtration shall be not more than the specified limits in IEEE Standard 519, 1992. calculations, unless specified otherwise, a power system short circuit ratio of 10 shall be assumed with all VFDs operating at maximum speed and maximum load. The point of common coupling for all harmonic calculations shall be defined as the primary connection of each VFD, unless specified otherwise.
4. Notching area, as defined by IEEE 519, shall be not more than 22,800 volt-microseconds. Notch depth shall not exceed 10% of normal peak voltage for line-to-neutral observations.

2.4 GENERAL

- A. Basic Description: The VFD shall consist of three sections: converter, inductor and inverter. These sections shall be grouped into separate sections with each section modularized for ease of troubleshooting. All SCRs in the converter and inverter sections will be standard rectifier grade devices containing the SCR manufacturer's standard catalog numbers such that they can be readily cross-referenced and interchanged with other SCR manufacturer's devices. SCR catalog numbers must be submitted as part of the submittal package. No fast switching SCRs will be allowed.
1. Converter: The converter section shall be a full wave, phase controlled, three-phase converter to change the input AC power to DC power. The output of the converter shall feed an inductor and the converter/inductor combination shall form a current source whose output is regulated and limited. The current limit feature of the converter shall be sufficiently fast and effective so as to protect against a sudden or random application of a short circuit to the output terminals of the current source.
 2. Inverter: The inverter section shall convert the DC power of the current source to adjustable frequency power to the motor. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
 3. Inductor: The drive shall contain an input AC reactor to allow the VFD to operate properly without an isolation transformer. The reactor shall attenuate the commutation notches generated by the VFD. The line reactor shall be mounted and wired within the drive enclosure.

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4. Power Bridges: The power bridge shall utilize an SCR configuration to provide a 12 pulse waveform to minimize harmonics on the main AC power line. The power bridge must be fed by a transformer with a second winding phase shifted 30 degrees electrically.
- B. The motor shall be squirrel-cage induction design in accordance with Section 16040 -Electric Motors, suitable for variable speed operation with the following additional features:
1. Copper windings.
 2. 120-V space heaters.
 3. High efficiency.
 4. Operating voltage: 480 V.
- C. Basic Features: The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 service factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as indicated. The controller shall have the following basic features:
1. The door of each power unit shall include:
 - a. Input disconnect switch handle integrally interlocked with power unit door.
 - b. One manual speed control potentiometer.
 - c. One 3-position mode selector switch marked "HAND-OFF-AUTOMATIC".
 - d. A " Power On" light.
 - e. A speed indicating meter with a range of 0 to 110% of full speed.
 - f. One elapsed time meter with five digits, without reset.
 - g. One VFD fault reset pushbutton.
 - h. One ammeter with a range of 0 to 125% of drive current rating.
 - i. One output voltmeter with a range of 600 V
 - j. VFD fault diagnostics.
 - k. Indicating lights to show running and ready status.

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2. Switches in the door shall control the drive as follows:
 - a. With the "HAND-OFF-AUTOMATIC" switch in the "HAND" position, the drive output speed shall be controlled by the manual potentiometer.
 - b. With the "HAND-OFF-AUTOMATIC" switch in the "AUTOMATIC" position, the drive shall start when an external isolated contact closes and its speed shall be controlled by a 4-20 mA external reference signal.
3. The VFD shall be selectable to provide automatic restart after a trip condition resulting from overcurrent, overvoltage, undervoltage, or over-temperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.
4. Speed Profile: Individual adjustable settings for start, stop, entry, slope, and minimum and maximum speed points. Speed reference shall be from an external 4 to 20 mA DC signal.
5. Control Circuit: Fused 120 VAC control transformer and control relays for system logic functions. For system logic, see electrical drawings.
6. Provision for an external 4 to 20 mA DC speed reference input signal. VFD manufacturer shall provide a signal current isolator to ensure signal and galvanic isolation of the grounded or ungrounded input speed reference signal. Where indicated, a frequency proportional 4 to 20 mA powered output signal shall be provided for external use and wired out to terminals.
7. Status and alarm outputs, each consisting of SPDT electrically isolated auxiliary contacts rated 5 A at 120 VAC.
 - a. Alarm output shall consist of two separate outputs; VFD fault, and motor fault. VFD fault is either:
 - (1) Output or input under-voltage.
 - (2) SCR over-temperature.
 - (3) Instantaneous overcurrent.
 - (4) Commutation failure.
 - (5) Converter saturation.
 - (6) Current limit timeout.

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- (7) Incorrect phase sequence or control power failure.
 - b. VFD and motor failure shall latch in the trip mode and shall require operator intervention to reset the drive.
 - c. Status outputs shall consist of three separate unpowered outputs; two run status outputs, and a VFD enable output. VFD enable status contacts shall monitor the emergency (coast to a stop) circuit. Wiring shall be as required by the electrical control diagrams.
8. Automatic and safety inputs, each consisting of a remote contact closure rated 5 A at 120 VAC maximum. Opening of the automatic input remote contact shall cause the motor speed to ramp down to zero speed by controlled deceleration. Opening of the safety input remote contact shall cause the VFD SCRs to be shorted and motor speed to coast to a complete stop. Wiring shall be as required by the electrical control diagrams.
9. Adjustable minimum to maximum frequency limits of 30 to 66 Hz.
10. Independent timed linear acceleration and deceleration functions, adjustable from 4 to 300 seconds.
11. Terminal blocks for wires entering and leaving the VFD unit. Terminals shall be identified with alpha- numeric characters identical to the terminal identifiers indicated on the schematic and connection diagrams.
12. Frequency regulator to operate within the following tolerances:
 - a. Frequency regulator span shall be 4 mA at minimum speed and 20 mA at maximum speed.
 - b. Frequency regulator accuracy shall be within 1.0% of span.
 - c. Frequency regulator deadband shall be within 0.5% of span.
 - d. Frequency regulator repeatability shall be within 0.5% of span.
 - e. Frequency reference signal input resistance shall be 0 to 550 ohms.
13. The VFD shall have Ethernet/IP communication port.

2.5 ENCLOSURE

- A. The enclosure shall be a dead-front, freestanding assembly with cabinet base and maximum dimensions as indicated. Working height shall be not greater

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than 74 inches. Doors shall be 11- gauge sheet steel with full length piano hinges. Removable lifting angles shall be provided.

- B. Unless otherwise indicated, the enclosure shall be NEMA 1 with gasketed doors and door openings. Enclosure shall be front access only, as indicated. The enclosure shall be suitable for either top or bottom cable entry as indicated.
- C. Enclosure shall be painted ANSI 61. Inside shall be white.

2.6 PROTECTIVE FEATURES AND CIRCUITS

- A. The controller shall include the following protective features:
 - 1. Static instantaneous overcurrent and overvoltage trip.
 - 2. Power loss and undervoltage protection.
 - 3. Power unit over-temperature protection.
 - 4. Electronic motor inverse time overload protection.
 - 5. Responsive action to motor winding and bearing temperature detectors and any bearing vibration switches indicated. All analog temperature signals shall be converted to contacts by the use of RTD relays or similar devices. Contacts shall open on fault condition or loss of relay power. RTD relays or similar devices shall be selected and provided by VFD manufacturer in coordination with the motor manufacturer. RTD relays or similar devices shall be mounted within the VFD cabinet.
 - 6. The VFD shall be capable of transient operation with a line voltage dip of 15% of normal operating voltage on a variable torque load. During line dip, the VFD shall automatically provide a speed droop limiting maximum capable speed for the duration of the input voltage dip.
 - 7. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed.
- B. The VFD system shall include distribution class arrestors to protect the VFD against voltage surges. The VFD shall include power fuses on the input to the converter rectifier.
- C. The power circuit design shall be such that the following fault conditions can occur without damage to the power circuit components:
 - 1. Single phase fault or three-phase short circuit on VFD output terminals.

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2. Failure to commutate inverter SCR due to severe overload or other conditions.
 3. Opening of VFD output contactor or motor disconnect switch during VFD operation.
 4. Loss of input power due to opening of VFD input disconnect device or utility power failure during VFD operation.
 5. Loss of one phase of input power.
- D. Drive shall be provided with a main circuit breaker or input fused disconnect switch, mechanically interlocked with the drive cabinet door. Interlock shall be provided with defeater. Unless otherwise indicated, circuit breaker or fuse shall have a minimum short circuit interrupting capacity of 30,000 RMS symmetrical amps.

2.7 CONTROL DEVICES

- A. Pilot devices and instruments shall be flush mounted on a VFD unit door. Pilot devices shall be heavy duty with contacts rated 10 A minimum at 600 VAC. Indicating lights shall be "push-to-test" type. Lens colors shall be in accordance with details shown on Drawings. Door-mounted indicating lights shall be removable without removing related wiring. The control units of a given type and size shall be made interchangeable. Relays shall be hermetically sealed.

2.8 DIAGNOSTICS

- A. The VFD shall include a microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

2.9 POWER FACTOR

- A. The collective power factor of the VFD and the motor, when running at full load amps, shall not be less than 0.95.

2.10 AIR COOLING REQUIREMENTS

- A. Air cooled VFDs shall be provided with 10% redundant fans and automatic switchover in the event of a fan failure for enhanced reliability. The drive shall have air flow detection switches to monitor the proper operation of the system and notify the operator of the blower system failure.
- B. When a VFD is installed in an ambient temperature above 104 degrees F, the VFD shall be equipped with an air conditioning unit to keep the temperature inside the enclosure within operating range of the equipment. The air conditioning unit shall be mounted on the side of the VFD and shall be powered from the VFD.

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2.11 SPARE PARTS

A. Spare Parts: Furnish the following spare parts for each VFD:

1. 1 printed circuit board of each type used.
2. 1 complete SCR bridge phase cell with snubbers.
3. 2 spare SCRs.
4. 2 spare diodes.
5. 5 spare light bulbs of each type used.
6. 3 spare fuses of each type used.
7. 2 spare relays of each type used.
8. 2 cans of aerosol spray touch-up paint.

2.12 FACTORY TESTING

A. Component Tests:

1. All components shall be 100% tested. Components shall be burned-in for 24 hours at 125 degrees F and retested to detect any drift. All printed circuit boards shall be burned-in continuously for 24 hours at 149 degrees F. The printed circuit boards shall be tested after burn-in to ensure they are functioning within specification. Every thyristor shall have the following critical parameters tested at rated current: gating, turn-on, turn-off, high temperature, forward blocking, reverse blocking, and waveform characteristics. All assembled phase cells shall be tested for cell balance at rated voltage, maximum current, maximum dV/dT and maximum dI/dT .
2. Control power shall be applied to microprocessors, printed circuit boards, diagnostic boards and similar devices including software to test for proper operation, sequencing, logic, and diagnostics.
3. All wiring shall be checked for continuity and for compliance with the wiring diagrams.

B. System Tests: Testing shall proceed in the order given below. For the motor test and the combined drive and motor test, submit a sketch of the proposed test setup, along with a description of the proposed testing procedure to the RESIDENT ENGINEER for acceptance at least 10 weeks in advance of the proposed testing date. No tests shall be performed until the test procedure meets with the RESIDENT ENGINEER'S approval. In addition, furnish the RESIDENT ENGINEER with at least 4 weeks advance written notice of the date

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and location of the system tests. The RESIDENT ENGINEER (at the option of either or both) reserve the right to witness the system tests.

1. Horizontal Motor Test:
 - a. Each variable frequency drive, along with the actual AC horizontal motor to be provided, shall be tested with the system logic and a dynamometer load coupled to simulate field operation conditions and be given complete factory tests at 25, 50, and 100% full load current.
 - b. After dynamometer tests are complete, the VFD shall be load-tested in a heat room maintained at 122 degrees F for 24 hours. The motor shall be cyclically loaded via the dynamometer as follows:
 - (1) 100% full load current for 6 hours
 - (2) 75% full load current for 6 hours
 - (3) 50% full load current for 6 hours
 - (4) 100% full load current for 6 hours
 - c. Failure of a SCR or other major components during this test requires repair and commencement of a new test. Motor and dynamometer need not be in the elevated temperature room with the VFD.
2. Vertical Motor Test: In the case of vertical motors, tests shall be identical to the ones required for horizontal motor except an electrically equivalent horizontal motor may be substituted for the actual vertical drive motor.
3. Harmonic Analysis for All Drives: Harmonic analysis shall be performed at unit full load using an harmonic analyzer by Hewlett Packard, or equal. Results shall be corrected for a source impedance delineated in terms of noncontributing short circuit amps listed below and shall be listed in a report. Tests shall prove that sufficient filtering has been provided to limit the harmonic distortion to a magnitude of 5% of the fundamental. The report shall include the following:
 - a. Expected harmonic components through the 49th harmonic, calculated with and without harmonic filtering.
 - b. RMS value of THD expected.

SECTION 11033 – VARIABLE FREQUENCY DRIVES

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. VFDs shall be installed in accordance with manufacturer's recommendations.
- B. Inspection, field adjustment and startup services shall be provided by manufacturer's service representative in accordance with Subsection 11033-1.6.

3.2 FIELD TESTING

- A. Field testing shall be performed in accordance with Section 16950 - Electrical Tests.

**** END OF SECTION ****

SECTION 11175 – PUMPS, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all pumps and pumping appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated in the CONTRACT DOCUMENTS.
- B. Unit Responsibility: A single manufacturer shall be responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each pump Section; however, the CONTRACTOR shall be responsible for compliance with the requirements of the individual pump Sections. Unless otherwise indicated, the single manufacturer shall be the manufacturer of the pump. Where two or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.
- C. Examination of Site Conditions: The supplier shall examine the site conditions, intended applications, and operation of the pumping system and recommend the pump which will satisfy the indicated requirement.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operations and Maintenance Information
 - 3. Section 09800 Protective Coatings
 - 4. Section 11000 Equipment General Provisions
 - 5. Section 11022 Variable Frequency Drive
 - 6. Section 11209 Submersible Sump Pumps
 - 7. Section 11214 Vertical Turbine Pumps
 - 8. Section 11220 Reservoir Sample Pump/Mixer
 - 9. Section 16040 Electric Motors

SECTION 11175 – PUMPS, GENERAL

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
2. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings Dimensions
3. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
4. ANSI/IEEE 115 Test Procedure for Synchronous Machines
5. ASTM A278 Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650oF
6. ASTM A395 Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
7. ASTM B62 Composition Bronze or Ounce Metal Castings
8. ASTM B584 Copper Alloy Sand Castings for General Applications
9. Hydraulic Institute, Inc. (HI) Test Code for Centrifugal Pumps

1.4 CONTRACTOR SUBMITTALS

A. General: CONTRACTOR submittals shall be furnished in accordance with Section 01300 - Submittals and Section 11000 - Equipment General Provisions.

B. Shop Drawings: Shop drawings and pump data sheets shall include the following information:

1. Pump name, identification number, and specification Section number.
2. Performance data curves showing head, capacity, horsepower demand, net positive suction head required (NPSHR), minimum submergence (for vertical turbine pumps), and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, NPSHR, and minimum submergence (for vertical turbine pumps) required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum

SECTION 11175 – PUMPS, GENERAL

speed shall be provided for each centrifugal pump equipped with a variable speed drive. For fixed speed driven pumps, the family of performance curves shall cover maximum diameter, rated and minimum diameter impellers.

3. Limits shall be indicated on the performance curves recommended for stable operation without cavitation or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.
 4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, bill of materials, outline dimensions, and shipping weights.
 5. Data in accordance with Section 16040 - Electric Motors, for the electric motor proposed for each pump.
 6. Data in accordance with Section 11033 – Variable Frequency Drive.
 7. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the Local Control Panel.
 8. Wiring diagram of field connections with identification of terminations between Local Control Panels, junction terminal boxes, and equipment items.
 9. Complete electrical schematic diagram.
 10. Completed pump data sheets.
- C. Operations and Maintenance Information: The CONTRACTOR shall submit information on pumps in accordance with the requirements of Section 01730 - Operations and Maintenance Information.
- D. Spare Parts List: The CONTRACTOR shall submit a Spare Parts List that contains the required information for each pump Section.
- E. Factory Test Data: The CONTRACTOR shall submit signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of the equipment.
- F. Certifications: The CONTRACTOR shall submit the following certifications:
1. Manufacturer's certification of proper installation.
 2. CONTRACTOR's certification of satisfactory field testing.

SECTION 11175 – PUMPS, GENERAL

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General: Compliance with the requirements of the individual pump Sections may necessitate modifications to the manufacturer's standard equipment.
- B. Performance Curves: All centrifugal pumps shall have a continuously rising curve of at least 10 percent. The required horsepower at any point on the performance curve shall not exceed the rated nameplate horsepower of the motor or engine. Encroachment into the service factor is only permitted on motors 150 hp and larger.
- C. Compatibility: All components of each pump system provided under the pump Sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors, variable speed controls if required, necessary mountings, and appurtenances.
- D. Pump Rating: The pump rated and normal flows shall straddle the pumps best efficiency point (BEP).
- E. Parallel Operation: Where parallel operation of pumps is required, the deviation in differential head at any given flow rate shall not exceed 2% between any two pumps. Performance test data must corroborate this requirement.
- F. Net Positive Suction Head Available: The net positive suction head available (NPSHA) shall exceed the NPSHR by a minimum of 3 feet at the rated condition.

2.2 MATERIALS

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
 - 1. Cast iron pump casings and bowls shall be either close-grained gray cast iron or ductile iron, conforming to ASTM A278 Class 30, or ASTM A395 respectively.
 - 2. Bronze pump impellers shall conform to ASTM B62, or ASTM B584, where dezincification does not exist.
 - 3. Pump shafts shall be constructed from materials identified under the respective pump types. Miscellaneous stainless steel parts shall be of Type 316.
 - 4. All anchor bolts, nuts, and washers shall be Type 416 stainless steel.

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2.3 PUMP COMPONENTS - GENERAL

- A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1, Class 125,
- B. Lubrication: Vertical pump shafts of clean water pumps shall be product water-lubricated, unless otherwise specified. Deep-well pumps and pumps with dry barrels shall have water- or oil-lubricated bearings seals with enclosed lineshafts. Horizontal pumps shall be lubricated with either oil or grease.
- C. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.
- D. Drains: All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink, or drain, with galvanized steel pipe or copper tube, properly supported with brackets.
- E. Grease Lubrication: For all vertical turbine pumps of bowl sizes 10 inches and larger, the CONTRACTOR shall provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.
- F. Seal Chambers: Where seal chambers are indicated for the pump seal, they shall be of the best quality, using the Manufacturer's suggested materials best suited for the specific application. For drainage and liquids containing sediments, the seals shall be fresh-water flushed, using lantern rings.
 - 1. Unless otherwise specified, the packing material shall be interlaced Teflon braiding, containing 50% ultrafine graphite impregnation to satisfy the following:
 - a. Shaft speeds - up to 2500 fpm
 - b. Temperature - up to 500 degrees F
 - c. pH range - 0 to 14
 - 2. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by John Crane Co., Lakos (Claude Laval Corp.), or equal.
- G. Mechanical Seals: Mechanical seals shall be fresh water-flushed unless indicated otherwise, in which case product water shall be used and shall be cleaned by a solids separator. Mechanical seals for hot and cold water pumps shall be single seals manufactured by Flowserve, Type I, 21 or Type L, or equal.
- H. Seal Buffer Fluid: The seal buffer fluid must be supplied at a minimum 20 psi above seal chamber pressure in order to maintain reliable seal performance.

SECTION 11175 – PUMPS, GENERAL

- I. Mechanical Seal Features: Mechanical seals for all services shall be equipped with nonclogging, single coil springs and nonsliding, internal, secondary elastomers. Metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C.
- J. Bearing Temperatures: The bearing temperature at the worst loading condition and ambient temperature shall not exceed 150 degrees F.

2.4 PUMP APPURTENANCES

- A. Nameplates: Each pump shall be equipped with a Type 316 stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer's name and model number.
- B. Solenoid Valves: The pump manufacturer, when required, shall provide solenoid valves on the flushing water or oil lubrication lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.
- C. Gauges:
 - 1. All pumps (sump pumps) shall be equipped with pressure gauges installed in pump suction and discharge lines. Pump suction lines shall be provided with compound gauges. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.
 - 2. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.
 - 3. Pressure and compound gauges shall be provided in accordance with Section 13334 - Pressure Measuring Systems.
 - 4. Gauge ranges shall be selected upon achieving utilization of 50-70% of the range for the rated conditions

2.5 FACTORY TESTING

- A. Inspection and Testing Costs: The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental, and 10 minutes per day of long distance phone calls to San Diego for an RESIDENT ENGINEER -designated inspector as required to complete such inspections or observations, exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. If the manufacturing plant operates a double shift, the costs of an additional RESIDENT ENGINEER -designated inspector shall be included in the inspection costs. At the option

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of the RESIDENT ENGINEER, full-time inspection will continue for the length of the manufacturing period. If the manufacturing period exceeds three consecutive weeks, the expenses of one 2-day trip per month by the RESIDENT ENGINEER shall be included. The CONTRACTOR shall not be responsible for salary or salary-related costs of the RESIDENT ENGINEER inspectors and supervisors.

B. Testing: The following tests shall be conducted on each indicated pump system:

1. Motors: All motors of sizes 100 hp and larger shall be assembled, tested, and certified at the motor factory and the working clearances checked to insure that all parts are properly fitted. The tests shall be in accordance with ANSI/IEEE 112 and ANSI/IEEE 115, including heat run and efficiency tests. All computations shall be recorded and certified and dated copies of the test results shall be furnished.
2. Pump Systems: All centrifugal pump systems 10 hp and larger shall be tested at the pump factory in accordance with the Test Code for Centrifugal Pumps of the Standards of the Hydraulic Institute, Inc. Tests shall be performed using the complete pump system to be furnished, including the motor. Calibration certificates for the motor(s) shall be provided to the pump manufacturer. For motors smaller than 100hp, the pump manufacturer's certified shop motor shall be acceptable. Testing of prototype models will not be acceptable. The following minimum test data shall be submitted:
 - a. Hydrostatic test data (30 minutes at 1.5 times the maximum allowable working pressure (MAWP))
 - b. A minimum of six hydraulic test readings shall be taken between shutoff and 125% of the BEP. Two of these points shall be the normal and rated capacities.
 - c. Pump curves showing head, flow, bhp, efficiency, and NPSHR.
 - d. Certification that the pump horsepower demand did not exceed the rated nameplate motor hp at any point on the curve (for motors under 150 hp).
3. Test tolerances for the performance testing shall be as follows based on the total dynamic head (TDH) range:

TDH Range (feet)	Rated Point	Shutoff
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0-500	+5, -2%	□±8%
501-1000	+3, -2%	□±6%

4. Vibration Limits:
- For pumps over 200 hp with sleeve bearings and sensing proximity probes: the maximum allowable overall shaft vibration (at maximum speed) shall not exceed 2.0 mils peak-to-peak throughout the full operating range. The maximum allowable transient shaft vibration shall be 3.5 mils peak-to-peak throughout the normal startup and shutdown speed range. These vibration values do not include shaft surface runout (electrical and mechanical) sensed by the probes. The maximum allowable shaft runout (roll speeds of less than 100 rpm) shall be less than 0.25 mils.
 - The maximum allowable bearing housing vibration at full operating speed shall not exceed 0.12 IPS RMS (whichever is smaller) throughout the normal operating flow range. The maximum allowable transient bearing housing vibration shall be 0.05 IPS zero to peak throughout the normal startup and shutdown speed range.
 - The machinery shall not exhibit unusual or abnormal frequency components when measured on either the shaft or the casing. Normal frequency components are defined as excitations such as rotational speed or blade passing frequency that are inherent with the mechanical construction of the machinery. Unusual or abnormal frequency components are excitations that are nonsynchronous or not related to the known geometry of the machinery. All vibration measurements taken during the performance testing shall utilize the project vibration instrument (when furnished).
5. Factory Witnessed Tests: All pumps, variable speed drives, and motors, 150 hp and larger shall be factory-tested as complete assembled systems and may be witnessed by the RESIDENT ENGINEER. The use of one of each type project motor and variable frequency drive for testing all pumps shall be acceptable. The CONTRACTOR shall give the RESIDENT ENGINEER a minimum of 4 weeks notification prior to the test. All costs for RESIDENT ENGINEER expenses shall be borne by the CONTRACTOR and shall be included in

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the bid price. Such costs shall include travel and subsistence for two people excluding salaries. Test results shall be submitted to the RESIDENT ENGINEER and no equipment shall be shipped until the test data have been approved by the RESIDENT ENGINEER..

- C. Acceptance: In the event of failure of any pump to meet any of the indicated requirements, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the CONTRACT DOCUMENTS and the pump shall be re-tested at no additional cost to the OWNER until found satisfactory.

PART 3 – EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: Where required by the individual pump Sections, the manufacturer's authorized service representative shall visit the site for the number of days indicated in those Sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
 - 1. Installation of the equipment.
 - 2. Inspection, checking, and adjusting the equipment .
 - 3. Startup and field testing for proper operation.
 - 4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified requirements.
- B. Instruction of the OWNER's Personnel:
 - 1. Where required by the individual pump Sections, the manufacturer's authorized training representative shall visit the site for the number of days indicated in those Sections to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
 - 2. The representative shall have at least two year's experience or training. A resume for the representative shall be submitted.
 - 3. Training shall be scheduled a minimum of three weeks in advance of the first session.
 - 4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

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5. The training materials shall remain with the trainees.
6. The RESIDENT ENGINEER may videotape the training for later use with the OWNER's personnel.

3.2 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. Alignment: All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: The CONTRACTOR shall provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

- A. Materials and equipment shall be coated in accordance with the requirements in Section 09800 - Protective Coating.

3.4 FIELD TESTS

- A. General: Where required by the individual pump Sections, each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.
- B. Field Tests: The following field testing shall be conducted:
 - 1 Startup, check, and operate the pump system over its entire speed range. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the RESIDENT ENGINEER.
 - 2 Obtain concurrent readings of motor voltage, amperage, pump suction, and pump discharge pressure for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance. Also obtain supply power quality.
 - 3 Determine bearing temperatures by contact type thermometer. A run time of at least four hours shall precede this test, unless insufficient liquid volume is available.
 - 4 Electrical and instrumentation tests shall conform to the requirements of the Sections under which that equipment is indicated.

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- C. Witnessing of Field Tests: Field testing will be witnessed by the RESIDENT ENGINEER. The CONTRACTOR shall furnish 5 days advance notice of field testing.
- D. Retesting: In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- E. Certification: After each pumping system has satisfied the requirements, the CONTRACTOR shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.
- F. Costs of Field Tests: The CONTRACTOR shall bear all costs of field tests, including related services of the Manufacturer's representative, except for power and water which the OWNER will bear.

**** END OF SECTION ****

SECTION 11209 – SUBMERSIBLE SUMP PUMPS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing submersible sump pumps with enclosed, submersible electric motors and all appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.
- B. The pump supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which best satisfies these requirements.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01680 Physical Checkout, Shop, Field, and Functional Testing
 - 3. Section 01730 Operation and Maintenance Information
 - 4. Section 01750 Spare Parts and Maintenance
 - 5. Section 09800 Protective Coating
 - 6. Section 11000 Equipment General Provisions
 - 7. Section 11175 Pumps, General
 - 8. Section 16040 Electric Motors
 - 9. Section 16050 Basic Electrical Materials and Methods

1.3 CONTRACTOR SUBMITTALS

- A. Submittals: Submittals shall be furnished in accordance with Section 01300 - Submittals, Section 11175 - Pumps, General, and the requirements herein.
- B. The CONTRACTOR shall submit the Submersible Sump Pump Data Sheets with information completed to the maximum extent possible.

SECTION 11209 – SUBMERSIBLE SUMP PUMPS

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pump Data: The attached Submersible Sump Pump Data Sheets identify the operation conditions, performance requirements, and pump dimension requirements for each submersible sump pump.
- B. Pump Construction: Construction of submersible sump pumps shall conform to the requirements indicated in the Submersible Sump Pump Data Sheets and the following requirements:
 - 1. The pump casing shall be cast iron.
 - 2. The impeller shall be semi-open, non-clog, cast iron.
 - 3. The bearings shall be permanently lubricated ball and sleeve type.
 - 4. The shaft shall be stainless steel, series 400.
 - 5. The seal shall be a mechanical seal.
 - 6. The mounting mechanism shall be a slide rail system, complete with cast iron 125 lb. 90 degree flanged elbow, stainless steel guide bars, Type 316 stainless steel chain and hook, and flanged steel discharge pipe. The sliding flange shall provide for mating of the pump casing to the elbow on the slide rail.
- C. Drives: The drive shall be an enclosed, submerged, electric 1800 rpm motor, suitable for 480 VAC, 3 phase, 60 Hz power supply, with armored cable, in accordance with Section 16040 - Electric Motors.

2.2 PROTECTIVE COATING

- A. Pumps shall be coated in accordance with Section 09800 - Protective Coating.

2.3 SPARE PARTS

- A. The CONTRACTOR shall furnish a complete set of the manufacturer's recommend spare parts for each submersible sump pump. Parts subject to wear, such as seals, o-rings, gaskets, and bearings shall be included.

2.4 MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
 - 1. ABS Pumps, Inc.
 - 2. Aurora Pumps.

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3. Chicago Pump Company (Yeomans)
4. Crane-Deming
5. Flygt Corporation
6. Goulds Pumps Inc.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Unless otherwise approved, submersible pumps shall be installed in accordance with the approved procedures submitted with the shop drawings and as shown on the Drawings.
- B. General installation requirements shall be as specified in Section 11175 - Pumps, General.

3.2 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this Specification.
 1. Submersible Pump Data Sheet.

**** END OF SECTION ****

SECTION 11214 – VERTICAL TURBINE PUMPS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide vertical turbine pumps and drives with associated piping, controls, wiring, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.
- B. The pump supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the pump requirements.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operation and Maintenance Information
 - 3. Section 01750 Spare Parts and Maintenance
 - 4. Section 03315 Grout
 - 5. Section 11000 Equipment General Provisions
 - 6. Section 11033 Variable Frequency Drives
 - 7. Section 11175 Pumps, General
 - 8. Section 16040 Electric Motors

1.3 CONTRACTOR SUBMITTALS

- A. Submittals: Submittals shall be furnished in accordance with Section 01300 - Submittals, Section 11175 - Pumps, General, and the requirements herein.
- B. Shop Drawings: The CONTRACTOR shall submit the following within 30 calendar days after the commencement date stated in the Notice to Proceed with construction.
 - 1. Experience Qualifications: A list of at least 10 vertical turbine pump installations, which meet the experience requirements, indicated below. Include the following information for each project:
 - a. Name of facility, owner of facility, contact name, address, and telephone number.

SECTION 11214 – VERTICAL TURBINE PUMPS

- b. Fluid pumped, capacity, head, horsepower, and speed.
 - c. Pump model number and size.
 - d. Year installed.
 - e. Local Maintenance Facility Qualifications: Service facility name, address, telephone number, and name of responsible manager. Experience record of local facility.
- C. CONTRACTOR shall submit the Vertical Turbine Pump Data Sheets with relevant information completed to the maximum extent possible.

1.4 QUALIFICATION REQUIREMENTS

- A. The pump manufacturer shall be experienced in the manufacture of canned vertical turbine pumps for at least 10 years. At least 10 canned vertical turbine pump installations of the same size units, 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, start-up, and operator training instruction.
- B. The manufacturer shall have a local service facility in California capable of installation, alignment, part replacement and stocking parts of pumps of the same size or larger as the units in this section.

1.5 WARRANTY

- A. The pump manufacturer shall warrant the pump and motor assemblies against material and workmanship defects for a period of 1 year which starts on the date of Substantial Completion of the Project. The CONTRACTOR shall submit the manufacturer's warranty document before final acceptance.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pump Data: The attached Pump Data Sheets identify the operation conditions, performance requirements, and pump dimension requirements for canned vertical turbine pumps.
- B. Pump Design, Construction, and Testing: Pump design, construction, and testing shall be in accordance with the requirements of Section 11175 - Pumps, General, the Vertical Turbine Pump Data Sheets, and the requirements herein. Construction of canned vertical turbine pumps shall conform to the following requirements:

- 1. Type - Vertical canned turbine pump.

SECTION 11214 – VERTICAL TURBINE PUMPS

2. Barrel or Can - Heavy duty steel, epoxy coated in accordance with Section 09800 - Protective Coating, for mounting in concrete encasement, designed to support the unit without vibration at any operating speed. Barrel or can shall be provided by the pump manufacturer.
3. Bowls - Cast-iron bowl units coated in accordance with Section 09800 - Protective Coating.
4. Impeller - Cast bronze (ASTM B62 or B584) statically and dynamically balanced.
5. Wear rings - Bronze.
6. Bowl Shaft - Type 316 stainless steel with Chromalloy (or equal) hard facing under bearing surfaces.
7. Suction Bell - Cast iron bell, with bottom bearing and streamlined ribs. Lining and coating in accordance with Section 09800 - Protective Coating.
8. Column - Steel pipe, not less than Schedule 30, lined and coated in accordance with Section 09800 - Protective Coating, in maximum 10-foot lengths, flanged with registered fit and through bolting.
9. Line shaft and couplings - Type 316 stainless steel with Chromalloy or equal hard facing under bearing areas, in maximum 10-foot lengths, sized for a critical speed of a minimum of 20% above the maximum operating speed. Shaft runout at seal chamber shall not exceed 0.002 inches. Shaft coupling Type 304 stainless steel.
10. Shaft lubrication - Fresh water lubricated, with solenoid valve.

SECTION 11214 – VERTICAL TURBINE PUMPS

11. Shaft seal - Mechanical with flushing water.
12. Bearings - Heavy-duty, grease-lubricated, bronze, extra length spiral grooved sleeve-type at maximum 5 feet centers. Minimum L-10 bearing life.
13. Discharge head - Fabricated steel, reinforced to withstand pipe thrust and maximum internal pressure, epoxy-lined in accordance with Section 09800 - Protective Coating, with flange, base plate, and minimum 1.25-inch, 3000-lb forged steel half-couplings for air valve, pressure switch, and drain connections.
14. Motor shaft coupling - 4-piece, heavy-duty adjustable spacer coupling, with registered fit, to allow for impeller adjustment. Spacer size shall permit mechanical seal removal without disturbing motor driver.
15. Bottom bearing - Bronze sleeve, with Type 316 stainless steel grease tube and fitting, extended to base plate. Minimum L-10 bearing life.
16. Bowl and suction - Product-lubricated bronze sleeves.

C. Drive:

1. Each pump shall be provided with a vertical, solid shaft, high efficiency, high thrust open drip proof, 480V, 3-phase, 60 Hz, heavy duty, electric motor in accordance with Section 16040 – Electric Motors. Each electric motor shall be designed to accept the total, unbalanced thrust (down thrust and momentary up thrust) imposed by the pump under all operating capacities and at shutoff.
2. In addition, the motors for Pump No. 1 and Pump No. 2 shall be inverter duty motors suitable for operation with variable speed drive in accordance with Section 11033 - Variable Frequency Drives. The variable frequency drive controller and components shall be housed in the Local Control Panel. Pump No. 3 is not equipped with VFD.

SECTION 11214 – VERTICAL TURBINE PUMPS

2.2 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 impellers
 - 4. One set of wear rings
 - 5. One set of all pump shaft bearings
 - 6. One mechanical seal
 - 7. Two sets of all gaskets and o-rings
 - 8. One set of special tools

2.3 MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
 - 1. Flowserve
 - 2. Goulds Pumps, Inc.
 - 3. Peerless Pumps
 - 4. Ingersoll-Dresser Pump Company
 - 5. Johnston

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: The manufacturer's representative shall be present at the site for 7 work days, to furnish the services required by Section 11175 - Pumps, General.
- B. Instruction of OWNER's Personnel: The training representative of the manufacturer shall be present at the site for 3 work days to furnish the services required by Section 11175 - Pumps, General.
- C. For the purposes of this Section, a work day is defined as an eight hour period at the site, excluding travel time.

SECTION 11214 – VERTICAL TURBINE PUMPS

- D. The RESIDENT ENGINEER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

3.2 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this Specification.
 - 1. Vertical Turbine Pump Data Sheets.

**** END OF SECTION ****

SECTION 11220 – RESERVOIR SAMPLE PUMP/MIXER

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide a reservoir sample pump with reservoir mixing capability.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 01680 Physical Checkout, Shop, Field, and Functional Testing
3. Section 01730 Operation and Maintenance Information
4. Section 01750 Spare Parts and Maintenance
5. Section 11000 Equipment General Provisions
6. Section 11175 Pumps, General
7. Section 16040 Electric Motors
8. Section 13300 Instrumentation and Control

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be furnished in accordance with Section 01300 - Submittals, Section 11175 - Pumps, General, and the requirements herein.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The reservoir mixing system shall be capable of eliminating water temperature stratification and achieving consistent chlorine residual levels throughout stored bodies of potable water through the vertical and circumferential mixing of the stored water.
- B. The system shall be capable of providing a pressurized supply sample of the stored water for remote analysis. This supply shall be available 24hrs per day at a minimum volume of 15 gallons per hour and at 20 psi or greater, when the pump is operating.

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- C. The system shall be capable of thorough and consistent mixing of injected disinfection chemicals by means of integral chemical injection points attached directly to the mixing unit. The ability to inject chemicals, whether utilized or not, must be included in this project to allow for future system improvements.
- D. The system shall be capable of consistent full-time operation by means of utility and/or solar powered electrical sources.

2.2 MANUFACTURER

- A. The reservoir mixing system(s) shall be the Vortex reservoir mixing system manufactured by Superior Water Technologies, or RESIDENT ENGINEER's approved equal.

2.3 SYSTEM REQUIREMENTS

- A. The reservoir mixing device shall be suspended from the proximate center of the reservoir. The mixing device will not be permitted to be installed through any existing hatch utilized for any other purpose.
- B. The device shall not be suspended from or tethered to an installation or retrieval cable.
- C. The mixing device shall not be in any direct contact with any interior surface of the reservoir structure.
- D. Any device utilizing water as a motive force must utilize water extracted directly from the reservoir by an integral mixing system pump. No remote water source or remote pump will be accepted.
- E. The mixer shall not require removal from the reservoir for normal maintenance, repair, or cleaning.
- F. The mixing system shall not require any entry of personnel or equipment into the reservoir tank for purposes of installing or maintaining the system.
- G. The equipment manufacturer shall have at least 5 years experience in the design and/or installation of similar mixing technologies for potable water storage tanks ranging in size from 1 MG to 15 MG.

2.4 NSF AND WATER QUALITY

- A. All wetted parts must be manufactured of materials accepted by the National Sanitation Foundation (NSF) for use in potable water systems.
- B. Materials of construction must be resistant to disinfection chemicals.

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- C. Materials of construction must be compatible with immersion in potable drinking water and in no way degrade or contaminate potable water over the entire life of the installed system
- D. The use of AC and/or DC electric motors and/or power cables or electric wiring is not permitted inside the water storage reservoir.

2.5 DUTY CONDITIONS

- A. The mixing system must be capable of operating on a continuous duty cycle, or controlled by a time clock for intermittent operation.
- B. The device must be capable of completely mixing the volume of water.
- C. The mixing system must allow the reservoir operator to maintain required water quality at up to 100 percent of reservoir capacity.
- D. The mixing system shall be designed to allow operation by means of non-utility supplied power sources such as solar or photovoltaic systems and gas or diesel powered generators.

2.6 DESIGN AND SAFETY CONSIDERATIONS

- A. Service of chemical injection points shall not require removal of mixing unit.
- B. The Tank Mixer System must be designed so that no part of the mixing system contacts any interior surface of the reservoir.
- C. The Tank Mixer System must provide the ability to remote monitor water quality such as chlorine and ammonia residuals, PH, and turbidity through a sample extracted directly from the mixer flow stream and provided at more than 20 psi directly by the mixing unit pump.
- D. The manufacturer shall be able to provide complete equipment layout and P&ID drawings.
- E. The mixing system shall be installed at a location away from the outer perimeter of the reservoir to provide a safe working environment for installers and operators of the system.
- F. Absolutely no electrical wiring or electric motors/pumps shall be installed in the reservoir.

2.7 RESERVOIR MIXER LOCAL CONTROL PANEL

- A. The reservoir mixer shall be provided with a local control panel (LCP) as part of the reservoir mixing system. LCP shall house the combination magnetic motor starter (or variable frequency drive) for the reservoir mixing pump motor, the controller for the mixing system, the input/output components to

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interface with the Main Pump Station PLC, HMI and field instrumentation, local disconnect switch, necessary power supply, control voltage transformer, air conditioning unit, hand switches, indicating lights, and all required components to supply a complete functional and operating reservoir mixing system.

- B. The reservoir mixer local control panel shall have a NEMA 4X (316 stainless steel) enclosure and shall be UL listed. The LCP shall be suitable to work with a 460-Volt, 3-phase, 60 Hz power supply.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Equipment installation shall meet all requirements of the electrical and mechanical specifications found elsewhere in the specifications.
- B. The Mixing System must be installed by technicians directly employed or supervised by the manufacturer. A manufacturer's representative must be on-site throughout the installation process.
- C. Manufacturer's installation supervisor must have a minimum of 5 years experience installing municipal water reservoir mixing systems and have installed in excess of 50 systems to qualify to supervise this installation.

3.2 WARRANTY AND SPARE PARTS

- A. A minimum three year parts and labor warranty is required on all components supplied and/or installed by the manufacturer.
- B. The manufacturer must provide a factory trained technician to the jobsite within 24 hours of an emergency callout.

3.3 TRAINING AND STARTUP

- A. The manufacturer shall verify the equipment installation and provide a signed report stating that the equipment is installed per manufacturer's recommendations to RESIDENT ENGINEER.
- B. A report of proper installation and acceptance shall be provided to the RESIDENT ENGINEER for any peripheral services supplied by a manufacturer's authorized provider.
- C.. Start-up service provided by the equipment manufacturer is required.

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- D. A minimum of one day of training services provided by a factory trained service technician is required.

**** END OF SECTION ****

SECTION 13080 – METAL ACOUSTIC WALL PANELS

PART 1 -- GENERAL

1.1 SUMMARY

- A. This section includes metal wall panels as shown on the Drawings.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 07920 Sealants and Caulking

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. C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients By The Reverberation Room Method

1.3 SUBMITTALS

- A. Manufacturer's Literature and Data:
 - 1. Product Data: Submit Manufacturer's technical data and brochures for each type of specified system required. All products furnished shall have a flame spread classification of 0-25 for a Class A or 1 rating in accordance with ASTM C423.
- B. Shop Drawings: Shop Drawings shall show dimensions, sizes, thickness, finishes, joining, attachments, relationship of adjoining work, and sound attenuating character.
- C. Shop Drawings shall be submitted in accordance with Section 01300 – Submittals.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Firm with manufacturing and delivery capacity required for the project, shall have successfully completed at least ten projects within the past five years, utilizing systems, materials and techniques as herein specified.

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- B. Fabricator must own and operate its own manufacturing facilities for all metal components. Systems consisting of components from a variety of manufacturers will not be considered or accepted.
- C. Manufacturer/Fabricator must own and operate its own Painting and Finishing facility to assure single source responsibility and quality control.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be protected during fabrication, shipment, site storage and erection to prevent damage to the finished work from other trades. Store wall panels inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

PART 2 -- PRODUCTS

2.1 SUPPLIER

- A. Acoustical Solutions, 2420 Grenoble Road., Richmond, VA 23294, (P) 800-782-5742, (F) 804-346-8808 or approved equal.
- B. The listed supplier shall not be construed as closing specifications to other prospective manufacturers, but rather as establishing a level of quality in a metal system. Suppliers of other systems shall submit all descriptive information of the system proposed including photographs and shop drawings of at least three projects similar in detail and scope.

2.2 SYSTEM DESCRIPTION

- A. Wall Panels shall be AlphaPerf™ Metal. All panels, perimeter trims and suspension components plus acoustical component shall be provided as a complete package of this work.

2.3 MATERIALS

- A. Galvanized steel sheets shall receive a factory applied and baked finish of Fluropon paint. Galvanized steel is recommended for interior use only. Paint color to be selected from standard colors by RESIDENT ENGINEER.
- B. Mounting Accessories (For Wall Mounted Baffle Panels)
 - 1. For surface mounting to structural wall, Z Clips are furnished in 18 gauges Galvanized steel, finished to match the Baffle Panel.
 - 2. For offset mounting, offset mounts are available for 1 inch, 2 inch or 4 inch spacing from the wall.
- C. Metal Panels

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1. Choose from the following selections for exposed metal (Gauge of material should be adequate to resist design loads as well as possible abuse in, for example, a gymnasium). Galvanized sheet (ASTM A366/A 366M) shall be minimum of .0216 -inch (26 Gauge).
2. The metal acoustical Wall Panels shall be corrugated using and perforated with 1/8 inch diameter holes on 21/64 inch staggered centers, approximately 13 percent open area.
3. The panels shall be fabricated of galvanized (26) gauge steel.
4. Acoustical Qualities:
 - a. Provide fiberglass 2 inch (1.5 # or 2# or equivalent density). The fiberglass panel shall be wrapped in Class A Polyvinylchloride, low gloss black.
 - b. All material as furnished shall be tested in accord with ASTM C-423 for Sound Absorption. Test results shall yield for mounting (D-40 Wall Mount) a NRC (Noise Reduction Coefficient) of 1.0 or 1.15.

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. Examine building structure scheduled to receive wall system for unevenness or irregularities that would affect quality and execution of work.

3.2 INSTALLATION

- A. General: Comply with manufacturer's printed instructions, governing regulations for Seismic Codes, and with the Interior Systems Construction Association standards applicable to work.
- B. Space Enclosure: Do not install any work until space is enclosed and weatherproofed, wet-work in space is completed and nominally dry, work above complete, and temperature and humidity is continuously maintained at values near those of final occupancy.
- C. Edge Trim:
 1. Install trim at perimeter using, maximum possible lengths, straight, true to line and level.
 2. Provide edge trim at junctions with other soffit finished, and where cut panel edges would be exposed.
- E. Metal Panels:

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1. Fit metal panel units in place, free from defects detrimental to appearance and function.
2. Install units in level, in uniform plane, and free from twist, warp and dents.
3. If necessary cut panels to fit borders and other penetrations.

3.3 CLEANING

- A. Clean all surfaces following installation.
- B. Replace units having scratched, abrasion, or other defects, with unblemished panels, or suspension.
- C. Maintenance per manufacturer's finish maintenance instructions.

3.4 PROTECTION

- A. Protection of AlphaPerf™ Acoustical systems from damage by other trades after installation to be provided by general contractor.

**** END OF SECTION ****

SECTION 13300 – INSTRUMENTATION AND CONTROL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all Instrumentation and Control systems (I&C) design and installation services complete and operable, in accordance with the CONTRACT DOCUMENTS. The requirements of this Section apply to all components of the I&C unless indicated otherwise.
- B. Responsibilities
 - 1. The CONTRACTOR, through the use of a qualified Instrumentation Subcontractor or vendor and qualified electrical and mechanical installers, shall be responsible to the RESIDENT ENGINEER for the implementation of the I&C and the integration of the I&C with other required instrumentation and control devices.
 - 2. Due to the complexities associated with the interfacing of numerous control system devices, the Instrumentation Subcontractor or vendor shall be responsible to the CONTRACTOR for the integration of the I&C with devices provided under other Sections and provide a completely integrated control system free of signal incompatibilities.
 - 3. As a minimum, the Instrumentation Subcontractor or vendor shall perform the following work:
 - a. Implementation of the I&C:
 - (1) Prepare shop-drawing submittals
 - (2) Design, develop, and electronically draft loop drawings and control panel designs
 - (3) Prepare the test plan, the training plan, and the spare parts submittals
 - (4) Procure hardware
 - (5) Fabricate panels
 - (6) Program the PLC
 - (7) Program the Operator Interface Terminal (OIT)
 - (8) Perform factory tests on panels
 - (9) Perform bench calibration and verify calibration after installation

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- (10) Install radio and antenna based on configuration provide by RESIDENT ENGINEER
 - (11) Oversee and certify installation
 - (12) Oversee, document, and certify loop testing
 - (13) Oversee, document, and certify system commissioning
 - (14) Conduct the performance test
 - (15) Prepare operations and maintenance information
 - (16) Conduct training classes
 - (17) Prepare record drawings
 - (18) Prepare calibration sheets
 - (19) Certify the installation of the I&C
- b. Integration of the I&C with instrumentation and control devices being provided under other Sections:
- (1) Develop all requisite loop drawings and record loop drawings associated with equipment provided under other Divisions and OWNER-furnished equipment.
 - (2) Resolve signal, power, or functional incompatibilities between the I&C and interfacing devices.
4. Instrumentation Subcontractor or vendor responsibilities in addition to the items identified above shall be at the discretion of the CONTRACTOR. Additional requirements in this Section and Division 13 that are stated to be the CONTRACTOR's responsibility may be performed by the Instrumentation Subcontractor or vendor.
- C. Certification of Intent:
1. Fifteen days after Notice of Apparent Low Bidder, the CONTRACTOR shall submit a certification from the selected Instrumentation Subcontractor or vendor. The certification shall be typed on letterhead paper of the Instrumentation Subcontractor or vendor firm. The certification shall be signed by an authorized representative of the Instrumentation Subcontractor or vendor. The certification shall include the following statements:
 - a. (Company name) "hereby certifies intent to assume and execute full responsibility to the CONTRACTOR to perform all

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tasks defined under Subsection 13300-1.1B3 in full compliance with the requirements of the CONTRACT DOCUMENTS."

- b. "It is certified that the quotation to the CONTRACTOR includes full and complete compliance with the requirements of the CONTRACT DOCUMENTS without exception."

D. Documentation of Instrumentation Subcontractor Qualifications:

1. List of at least two instrumentation and control system projects successfully completed, of size and scope similar to that described herein, in which the applicant performed system engineering, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and start-up, operator instruction and maintenance training. Each of the references cited must be accompanied by a written confirmation of the accuracy of the data by a managerial member of the control system operational staff.
2. In addition, list the following information for each project above:
 - a. Name of plant, OWNER, contact name and telephone number. All phone numbers and contacts shall be verified by the applicant before submission.
 - b. Name of manufacturer(s) for the majority of instrumentation provided.
 - c. Type of equipment furnished (i.e., transmitters, recorders, indicators, etc.)
 - d. Manufacturer and model number of DCS, SCADA, or PLC to which the analog system interfaced.
 - e. Date of completion or acceptance.
3. Furnish the name of the individual person who will be responsible for office engineering and management of this project, and the individual who will be responsible for field testing, calibration, start-up, and operator training for this project. Include references of recent projects of these individual persons.
4. Submit specific documentation which verifies that Instrumentation Subcontractor employs the minimum of individuals who have been formally trained in the application of the:
 - a. Indicated operating systems.
 - b. Indicated software packages.

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- c. Indicated graphical user interface software packages.
5. Document that the applicant's company has been actively involved in the instrumentation systems business (under the same corporate name).

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 01730 Operations and Maintenance Information
3. Section 11209 Submersible Sump Pumps
4. Section 11214 Vertical Turbine Pumps
5. Section 11220 Reservoir Sample Pump/Mixer
6. Section 13344 Temperature Measuring Systems
7. Section 15117 Pump Control Valves
8. Section 16040 Electric Motors
9. Section 16200 Engine Generator
10. Section 16050 Basic Electrical Materials and Methods.
11. Division 13.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal code:

1. National Electrical Code (NEC).
2. Uniform Building Code (UBC).

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

1. ANSI/SA S 5.1 Instrumentation Symbols and Identification.

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2. ISA-S20 Specification Forms for Process Measurement and Control Instruments.

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals and the following:

1. Coordinate the instrumentation Work so that the complete instrumentation and control system will be provided and will be supported by accurate shop drawings and record drawings.
2. Symbology and Nomenclature: In these CONTRACT DOCUMENTS, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from International Society of Automation Standard ANSI/ISA S5.1 - Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout shop drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

- B. Presubmittal Conference:

1. Arrange and conduct a Presubmittal Conference within 30 days after award of the contract. The purpose of the Presubmittal Conference is to review and approve the manner in which the CONTRACTOR intends to carry out its responsibilities for shop drawing submittal on the Work to be provided under this Section. The CONTRACTOR, the Instrumentation Subcontractor or vendor, and the RESIDENT ENGINEER shall attend. Both the CONTRACTOR and the RESIDENT ENGINEER may invite additional parties at their discretion.
2. Allow one, 8-hour day for the Presubmittal Conference.
3. Submit 3 copies of the following items for discussion at the Presubmittal Conference:
 - a. A list of equipment and materials required for the I&C and the manufacturer's name and model number for each proposed item.
 - b. A list of proposed clarifications to the CONTRACT DOCUMENTS along with a brief explanation of each. Resolution shall be subject to a separate formal submittal and review by the RESIDENT ENGINEER.

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- c. A sample of each type of submittal specified herein.
 - d. A flow chart showing the steps to be taken in preparing and coordinating each submittal.
 - e. A bar-chart type schedule for all system related activities from the Presubmittal Conference through start-up and training. Dates of submittals, design, fabrication, programming, factory testing, deliveries, installation, field testing, and training shall be shown. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.
 - f. An overview of the proposed training plan. The RESIDENT ENGINEER will review the overview and may request changes. All changes to the proposed training shall be resolved at the Presubmittal Conference. The overview shall include the following for each proposed course:
 - (1) Course title and objectives.
 - (2) Prerequisite training and experience of attendees.
 - (3) Course content - a topical outline.
 - (4) Course duration.
 - (5) Course format - lecture, laboratory demonstration, etc.
 - g. A preliminary copy of the Instrumentation Subcontractor Qualification submittal.
4. Take minutes of the Presubmittal Conference, including all events, questions, and resolutions. Before adjournment, all parties must concur with the accuracy of the minutes and sign accordingly.
- C. Shop Drawings:
- 1. General:
 - a. Preparation of shop drawings shall not start until adjournment of the Presubmittal Conference.
 - b. Shop drawings shall include the letter head or title block of the Instrumentation Subcontractor. The title block shall include, as a minimum, the Instrumentation Subcontractor's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.

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- c. Organization of the shop drawing submittals shall be compatible with eventual submittals for later inclusion in the operations and maintenance information submitted in accordance with Section 01730 - Operations and Maintenance Information. Submittals that are improperly organized or incomplete for a given loop will be rejected.
 - d. Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the I&C shall be included in the shop drawing submittal.
2. Instrument Submittal: Submit the instrument submittal as a complete bound package at one time within 60 calendar days after the commencement date stated in the Notice to Proceed, including:
- a. A complete index that lists each device by tag number, type, and Manufacturer. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
 - b. Fully executed data sheets according to ISA-S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to all Contract Document requirements. The data sheets, as a minimum, shall show:
 - (1) Component functional description used in the Contract Documents
 - (2) Manufacturer's model number or other product designation
 - (3) Project tag number used in the Contract Documents
 - (4) Project system or loop of which the component is a part

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- (5) Project location or assembly at which the component is to be installed
 - (6) Input and output characteristics
 - (7) Scale, range, units, and multiplier (if any)
 - (8) Requirements for electric supply (if any)
 - (9) Requirements for air supply (if any)
 - (10) Materials of component parts to be in contact with or otherwise exposed to process media and corrosive ambient air
 - (11) Special requirements or features
- c. Flow Meter Sizing Calculations: Calculations shall be submitted on the Instrument Manufacturer letterhead and shall include the following:
- (1) Proposed flow meter size based on indicated minimum, maximum and average flow rates
 - (2) Guaranteed flow meter accuracy based on the upstream and downstream straight runs associated with the location of each flow meter
 - (3) Permanent head loss associated with each flow meter
 - (4) Flow vs. differential pressure curves for all head-type devices. For compressible fluids, curves shall be pressure and temperature compensated.
 - (5) References to ASME and ISA standard equations used
 - (6) Values used for all parameters used in calculations
- d. Calibration sheets in accordance with Subsection 13300-1.4C5.
- e. Priced list of all spare parts for all devices
- f. Instrument installation, mounting, and anchoring details shall be submitted in an electronic BENTLEY MICROSTATION format and hard copy format. Each instrument shall have a dedicated 8-1/2 inches X 11" detail that pertains to the specific instrument by tag number. Instruments that share the same installation detail shall be tabulated by tag numbers on the

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same detail sheet. As a minimum, each detail shall have the following content:

- (1) Show all necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor.
 - (2) Ambient temperature and humidity of the environment where the instrument will be installed.
 - (3) Corrosive qualities of the environment where the instrument will be installed.
 - (4) Hazardous rating of the environment where the instrument will be installed.
 - (5) Process line pipe or tank size, service and material.
 - (6) Process tap elevation and location
 - (7) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.
 - (8) Routing of tubing and identification of supports.
 - (9) Mounting brackets, stands, and anchoring devices.
 - (10) Conduit entry size, number, location, and delineation between power and signal.
 - (11) NEMA ratings of enclosures and all components.
 - (12) Clearances required for instrument servicing.
 - (13) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.
3. Project-Wide Loop Drawing Submittal: Furnish a Project-wide Loop Drawing Submittal (PLDS) that completely defines and documents the contents of each monitoring, alarming, interlock, and control loop associated with equipment provided under the instrumentation sections, equipment provided under sections in other Divisions, existing, and OWNER-furnished equipment that is to be incorporated into the I&C. The PLDS shall be a singular complete bound package

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electronically drafted in BENTLEY MICROSTATION format, submitted within 120 days after contract award, and shall include the following:

- a. A complete index in the front of each bound volume. The loop drawings shall be indexed by systems or process areas. All loops shall be tagged in a manner consistent with the CONTRACT DOCUMENTS. Loop drawings shall be submitted for every analog and discrete monitoring and control loop.
- b. Drawings showing definitive diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ANSI/ISA S5.4 - Instrument Loop Drawings, and as defined by the most recent revision in ISA. Each system or loop diagram shall be drawn on a separate drawing sheet. Loop drawings shall be developed for loops in equipment vendor supplied packages, equipment provided under the instrumentation sections, and OWNER furnished equipment. The loop drawings shall also show all software modules and linkages. In addition to the expanded ISA S5.4 requirements the loop diagrams shall also show the following details:
 - (1) Functional name of each loop.
 - (2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
 - (3) MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.
 - (4) Designation, and if appropriate, terminal assignments associated with every manhole, pullbox, junction box, conduit, and panel through which the loop circuits pass.
 - (5) Vendor panel, instrument panel, conduit, junction boxes, equipment and PLC I/O terminations, termination identification wire numbers and colors, power circuits, and ground identifications.
- c. Itemized instrument summary. The summary shall be prepared with Lotus 1-2-3 software and shall be submitted on 3-1/2-inch floppy disks and hard copy. The instrument summary shall list all of the key attributes of each instrument provided under this Contract. As a minimum, attributes shall include:
 - (1) Tag number

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- (2) Manufacturer
 - (3) Model number
 - (4) Service
 - (5) Area location
 - (6) Calibrated range
 - (7) Loop drawing number
 - (8) Associated LCP, PLC, PCM, or RTU
4. Test Procedure Submittals:
 - a. Submit the proposed procedures to be followed during tests of the I&C and its components.
 - b. Preliminary Submittal: Outlines of the specific proposed tests and examples of proposed forms and checklists.
 - c. Detailed Submittal: After approval of the Preliminary Submittal, the CONTRACTOR shall submit the proposed detailed test procedures, forms, and checklists. This submittal shall include a statement of test objectives with the test procedures.
 - d. Certify in writing that for each loop or system checked out, and all discrepancies have been corrected.
 5. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
 - a. Project name
 - b. Loop number
 - c. Tag number
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Calibration range

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- h. Calibration data: Input, output, and error at 10, 50 and 90% of span
 - i. Switch setting, contact action, and deadband for discrete elements
 - j. Space for comments
 - k. Space for sign-off by Instrumentation Supplier and date
 - l. Test equipment used and associated serial numbers
6. Training Submittals: Subsequent to the receipt of the RESIDENT ENGINEER's input made at the Presubmittal Conference, the CONTRACTOR shall submit a training plan that includes:
- a. A resubmittal of the training plan overview from the Presubmittal Conference with incorporation of all modifications agreed upon at that meeting.
 - b. Schedule of training courses including dates, durations, and locations of each class.
 - c. Resumes of the instructors who will actually implement the plan.
- D. Operations and Maintenance Information:
- 1. General: Operations and maintenance information shall be based upon the approved shop drawing submittals as modified for conditions encountered in the field during the Work.
 - 2. Operations and maintenance information submitted in compliance with Section 01730 - Operations and Maintenance Information .
 - 3. Operations and Maintenance Information shall be organized as follows for each process:
 - a. Section A - Process and Instrumentation Diagrams
 - b. Section B - Loop Descriptions
 - c. Section C - Loop Drawings
 - d. Section D - Instrument Summary
 - e. Section E - Instrument Data Sheets
 - f. Section F - Sizing Calculations

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- g. Section G - Instrument Installation Details
 - h. Section H - Test Results
4. CONTRACTOR-certified results from Calibration Loop Testing, Precommissioning, and Performance Testing shall be included in Section H of the operations and maintenance information.
 5. Start-up of systems shall begin no sooner than 15 days after final approval of the I&C operations and maintenance information provided in compliance with Section 01730 - Operations and Maintenance Information.
- E. Record Drawings:
1. Keep current a set of complete loop and schematic diagrams which shall include all field and panel wiring, piping and tubing runs, routing, mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements. One set of record drawings electronically formatted in BENTLEY MICROSTATION format and 2 hard copies shall be submitted after completion of all Precommissioning tasks but before Performance Testing. All such drawings shall be submitted for review before acceptance of the completed Work.

1.5 FACTORY TESTING

- A. Arrange for the Manufacturers of the equipment and fabricators of panels and cabinets supplied under this Section to allow the RESIDENT ENGINEER or individual assigned by the RESIDENT ENGINEER , to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices. A minimum of 10 working days notification shall be provided to the RESIDENT ENGINEER before testing. No shipments shall be made without the RESIDENT ENGINEER's approval.

1.6 PERIOD FOR CORRECTION OF DEFECTS

- A. Correct all defects in the I&C upon notification from the RESIDENT ENGINEER within one year from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Code and Regulatory Compliance: All I&C Work shall conform to or exceed the applicable requirements of the National Electrical Code. Conflicts between the

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requirements of the CONTRACT DOCUMENTS and any codes or referenced standards or specifications shall be resolved.

- B. **Current Technology:** All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.
- C. **Hardware Commonality:** All instruments that use a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head) shall be furnished by a single Manufacturer. All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.
- D. **Loop Accuracy:** The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of +0.5% of full scale and a minimum repeatability of +0.25% of full scale unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.
- E. **Instrument and Loop Power:** Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the Manufacturer's instrument load characteristics to ensure sufficient power to each loop component. All power supplies shall be mounted within control panels or in the field at the point of application.
- F. **Loop Isolators and Convertors:** Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wire-wound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and convertors shall be provided where required to resolve any signal level incompatibilities or provide required functions.
- G. **Environmental Suitability:** All indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the CONTRACT DOCUMENTS. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20% within the minimums and maximums of their rated environmental operating ranges. Provide all power

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wiring for these devices. Enclosures suitable for the environment shall be furnished.

- H. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 mA DC except as indicated. Signals within enclosures may be 1 to 5 VDC. All electric signals shall be electrically or optically isolated from other signals. All pneumatic signals shall be 3 to 15 psig with 3 psig equal to 0% and 15 psig equal to 100%.
- I. Control Panel Power Supplies: All control panels shall be provided with redundant power supplies that are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. All power supplies shall have an excess rated capacity of 40%. The failure of a power supply shall be annunciated at the control panel and repeated to the SCADA System.
- J. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the RESIDENT ENGINEER through the "or equal" process of Section 01600 Materials and Equipment. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

2.2 OPERATING CONDITIONS

- A. The I&C shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:
 - 1. Environment - water treatment or pumping facility
 - 2. Temperature Range - 32 through 104 degrees F
 - 3. Thermal Shock - 1 degree F per minute, maximum
 - 4. Relative Humidity - 20 through 90%, non-condensing

2.3 SPARE PARTS AND SPECIAL TOOLS

- A. Spare Parts: Furnish the spare parts selected by the RESIDENT ENGINEER from the priced list of spare parts in the Instrument Submittal and Control Panel Engineering Submittal in conformance with Section 13370 - Control Panels.
- B. Special Tools: Furnish a priced list of all special tools required to calibrate and maintain all of the instrumentation provided under the CONTRACT DOCUMENTS. After approval, furnish all listed tools.

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- C. Timing of Submittals: All special tools and spare parts shall be submitted before startup starts, and shall be suitably wrapped and identified.

2.4 MISCELLANEOUS INSTRUMENTS

A. Intrusion Switch

1. Intrusion switches shall monitor intrusion at entry points such as doors, and overhead hatch doors. Switches shall be magnetic, and consist of magnet, switch and cabling. Magnet shall be 2.5inch long, suitable for surface mounting at door, complete with mounting accessories and connected with an armored, 36 inch long cable. The switch shall be 2.6inch long, 0.875inch wide by 0,6inch thick. Housing shall be weather resistant aluminum.
2. Switch shall be normally open, with a contact rating of 10Watt DC. Maximum voltage shall be 200V DC and maximum switching current shall be 0.5Amp DC.
3. Switch shall be George Risk Industries, model 4400A with switch.

B. Smoke Detector (Air)

1. Smoke detectors shall monitor process air, and provide contact closure when smoke is detected. The detector shall be photo detection type with 135 degree F fixed heat sensor. It shall be a 4-wire device, with 24V DC power.
2. Field sensitivity of the detector shall meet NFPA 72 requirements, it shall be provided with a mounting bracket and a tamper resistance feature. Switch shall have Form C contacts rated for 2Amps at 24V DC.
3. Smoke alarm detector shall be System Sensor, model 4WT-B.

PART 3 -- EXECUTION

3.1 PRODUCT HANDLING

- A. Shipping Precautions: After completion of shop assembly, factory test, and approval, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

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- B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the Manufacturer shall be securely attached to each piece of equipment before packaging and shipment.
- C. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the I&C. Identification shall be prominently displayed on the outside of the package.
- D. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at no additional cost to the OWNER. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the RESIDENT ENGINEER. Such tests shall be at no additional cost to the OWNER, and if the equipment fails the tests, it shall be replaced at no additional cost to the OWNER.

3.2 MANUFACTURER'S SERVICES

- A. Manufacturer's services shall be furnished for the following equipment:
 - 1. All flow meters in new or potable water streams that relate to process control.
 - 2. All process analyzers
 - 3. Ultrasonic level transmitter
 - 4. Instruments that require specialized knowledge, such as vibration detectors.
 - 5. Programmable Logic Controller System
- B. Furnish the following Manufacturer's services for the instrumentation listed above:
 - 1. Perform bench calibration
 - 2. Oversee installation
 - 3. Verify installation of installed instrument
 - 4. Certify installation and reconfirm Manufacturer's accuracy statement

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5. Oversee loop testing, prepare loop validation sheets, and certify loop testing
6. Oversee precommissioning, prepare precommissioning validation sheets, and certify precommissioning
7. Train the OWNER's personnel

3.3 INSTALLATION

A. General:

1. All instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 13 and the manufacturers' instructions.
2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the RESIDENT ENGINEER exercises the right to require changes in location of equipment that do not impact material quantities or cause material rework, make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring

1. All conduit shall be provided under Division 16.
2. All 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, SCADA and PLC input and output wiring and other field wiring and cables shall be provided under Division 16.
3. All SCADA and PLC equipment cables, data highway communication networks shall be provided under Division 13.
4. All terminations and wire identification at I&C equipment furnished under this or any other Division shall be provided under Division 13.

C. Instrumentation Tie-Downs: All instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements that apply to the site.

D. Ancillary Devices: The CONTRACT DOCUMENTS show all necessary conduit and instruments required to make a complete instrumentation system. The

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CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements at no additional cost to the OWNER. All such additions and all such changes, including the proposed method of installation, shall be submitted to the RESIDENT ENGINEER for approval before commencing the Work. Such changes shall not be a basis of claims for extra work or delay.

- E. Installation Criteria and Validation: All field-mounted components and assemblies shall be installed and connected according to the requirements below:
1. Installation personnel have been instructed on installation requirements of the CONTRACT DOCUMENTS.
 2. Technical assistance is available to installation personnel at least by telephone.
 3. Installation personnel have at least one copy of the approved shop drawings and data.
 4. Instrument process sensing lines shall be installed similar to conduit specified under Section 16050 - Basic Electrical Materials and Methods. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.
 5. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square-cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.
 6. All differential pressure elements shall have three valve manifolds.
 7. All flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
 8. All power and signal wires shall be terminated with crimped type lugs.
 9. All connectors shall be, as a minimum, water tight.
 10. All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
 11. All wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the RESIDENT ENGINEER. All wiring shall be protected from sharp edges and corners.

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12. All mounting stands and bracket materials and workmanship shall comply with requirements of the CONTRACT DOCUMENTS.
13. Verify the correctness of each installation, including polarity of electric power and signal connections, and making sure all process connections are free of leaks. Certify in writing that for each loop or system checked out, all discrepancies have been corrected.
14. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the Instrumentation Subcontractor.

3.4 CALIBRATION

- A. General: All devices provided under the instrumentation sections shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.
- B. Calibration Points: Each instrument shall be calibrated at 20, 40, 60, 80 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.
- C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the RESIDENT ENGINEER.
- D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.
- E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. All samples and sample gases shall be furnished by the manufacturers.
- F. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the RESIDENT ENGINEER. Have the Instrumentation Supplier sign the tag when calibration is complete. The RESIDENT ENGINEER will sign the tag when the calibration and testing has been accepted.

3.5 LOOP TESTING

- A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the RESIDENT ENGINEER for review before the loop tests. The CONTRACTOR shall

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notify the RESIDENT ENGINEER of scheduled tests a minimum of [30] days before the estimated completion date of installation and wiring of the I&C. After the RESIDENT ENGINEER's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the RESIDENT ENGINEER.

- B. Control Valve Tests: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.
- C. Interlocks: All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.
- D. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance its Manufacturer's specifications and instructions. Any instrument that fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the RESIDENT ENGINEER at no additional cost to the OWNER.
- E. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA and PLC. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Specified accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks that incorporate analog elements, simulated sensor inputs corresponding to 20, 40, 60, 80 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All

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analog loop test data shall be recorded on test that include calculated root-mean-square-summation system accuracy tolerance requirements for each output.

- F. Loop Validation Sheets: Prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:

1. Project name
2. Loop number
3. Tag number, description, manufacturer and model number for each element
4. Installation bulletin number
5. Specification sheet number
6. Loop description number
7. Adjustment check
8. Space for comments
9. Space for loop sign-off by Instrumentation Supplier and date
10. Space for RESIDENT ENGINEER witness signature and date

- G. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the RESIDENT ENGINEER or the RESIDENT ENGINEER representative as a witness, with test data entered, shall be submitted to the RESIDENT ENGINEER together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

3.6 PRECOMMISSIONING

- A. General: Precommissioning shall start after acceptance of all wire test, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Precommissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

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- B. Precommissioning Procedures and Documentation: All precommissioning and test activities shall follow detailed test procedures and check lists accepted by the RESIDENT ENGINEER. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the RESIDENT ENGINEER, that include calculated tolerance limits for each step. Completion of all system precommissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the RESIDENT ENGINEER with a clear and unequivocal statement that all system precommissioning and test requirements have been satisfied.
- C. Operational Validation: Where feasible, system precommissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.
- D. Loop Tuning: All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100% of span and the results checked against indicated accuracy tolerances.
- E. Precommissioning Validation Sheets: Precommissioning shall be documented on one of two types of test forms as follows:
1. For functions that can be demonstrated on a loop-by-loop basis, the form shall include:
 - a. Project name
 - b. Loop number

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- c. Loop description
 - d. Tag number, description, manufacturer and data sheet number for each component.
 - e. Space for sign-off and date by both the Instrumentation Subcontractor and RESIDENT ENGINEER.
 2. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:
 - a. Specification page and paragraph of function demonstrated
 - b. Description of function
 - c. Space for sign-off and date by both the Instrumentation Subcontractor and RESIDENT ENGINEER.
- F. Precommissioning Certification: Submit an instrumentation and control system precommissioning completion report that shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the precommissioning testing. Acceptance of the instrumentation and control system precommissioning testing must be provided in writing by the RESIDENT ENGINEER before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.7 ONSITE SUPERVISION

- A. Furnish the services of an on-site service engineer to supervise and coordinate installation, adjustment, testing, and start-up of the I&C. The RESIDENT ENGINEER will be present during the total period required to effect a complete operating system. A qualified team of the Instrumentation Subcontractor personnel shall be on site to the satisfaction of the RESIDENT ENGINEER to check all equipment, perform the tests indicated in this Section, and furnish startup services.

3.8 PERFORMANCE TEST

- A. The entire I&C shall operate for 30 days without failure.
- B. Furnish all necessary support staff as required to operate the system and to satisfy the repair or replacement requirements.
- C. If any component fails during the performance test, it shall be repaired or replaced and the I&C shall be restarted on another 30-day period.

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3.9 TRAINING

- A. General: Train the OWNER's personnel on the maintenance, calibration and repair of all instruments provided under this Contract.
- B. Instructions: The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.
- C. Duration: Each training class shall be a minimum of 8 hours in duration and shall cover, as a minimum, operational theory, maintenance, troubleshooting/repair, and calibration of instruments.
- D. Schedule: Training shall be performed during the precommissioning phase of the project. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The RESIDENT ENGINEER will review the course outline for suitability and provide comments that shall be incorporated.
- E. Agenda: The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.
- F. Documentation: Within 10 days after the completion of each session the CONTRACTOR shall submit the following:
 - 1. List of all OWNER personnel who attended the session.
 - 2. Evaluation of OWNER personnel via written testing or equivalent evaluation.
 - 3. Copy of the training materials used including all notes, diagrams, and comments.

3.10 ACCEPTANCE

- A. For the purpose of this Section, the following conditions shall be fulfilled before the Work is considered substantially complete:
 - 1. All submittals have been completed and approved.
 - 2. The I&C has been calibrated, loop tested and precommissioned.
 - 3. The OWNER training has been performed.
 - 4. All required spare parts and expendable supplies and test equipment have been delivered to the RESIDENT ENGINEER.
 - 5. The performance test has been successfully completed.

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6. All punch-list items have been corrected.
7. All record drawings in both hard copy and electronic format have been submitted.
8. Revisions to the operations and maintenance manuals information that may have resulted from the field tests have been made and reviewed.
9. All debris associated with installation of instrumentation has been removed.
10. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

**** END OF SECTION ****

SECTION 13301 – INSTRUMENTATION AND CONTROL DESCRIPTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. This Section describes the Instrumentation and Control (I&C) system for the Project.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Division 11
 - 2. Division 13
 - 3. Division 16

PART 2 -- PRODUCTS

2.1 THE CONTROL SYSTEM ARCHITECTURE

- A. A new PLC control system shall be provided and programmed by the CONTRACTOR as shown in the contract documents and specifications. The CONTRACTOR shall provide new system and demonstrate the radio communications network for the new PLC interfacing with the existing network. The radio communications network provided shall include all of the hardware and software necessary to allow the existing control room at the Alvarado Pump Station (APS) to read and write to the PLC provided at the La Jolla Pump Station by the CONTRACTOR.
- B. The existing SCADA system at APS shall be capable of monitoring all input signals available to the PLC. APS shall also be capable of limited process control functions such as changing set-points, or modifying start and stop schedules etc. The City will be responsible for SCADA configuration at APS for the pump station and reservoir.
- C. An Operator Interface Terminal (OIT) shall be installed on the front face of the PLC panel by the CONTRACTOR. The OIT shall be programmed to display all analog parameters and all status and alarm signals which the PLC receives. It shall not be possible for the operator to modify any set points from the OIT.
- D. The CONTRACTOR shall be responsible for providing and testing all communications hardware, cabling and connectors necessary to bring the radio communication link to the existing network. The radio survey will be performed by the City, which the CONTRACTOR will use to assist in bringing the radio communication link to the existing network.

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2.2 CONTROL STRATEGIES

- A. General: The following loop descriptions define the control strategies for each individual loop associated with the Process and Instrumentation Diagrams (P&IDs). The titles of loops are based on P&ID number and loop title. The loop descriptions are organized as follows, with the relevant components of the list below identified for each loop:
1. Overview: General description of system and operations.
 2. Tags and Loops: The site identifier JCC shall precede all tag numbers.
 3. Interlocks: abstract of interlocks for hard wired and software logic.
 4. PLC Special Functions: Non-standard PLC functions
 5. SCADA Special Functions: Non-standard SCADA functions
 6. SCADA Alarms
 7. SCADA Setpoints
- B. P&ID I-2, Influent Altitude Valve
1. Overview: CONTRACTOR shall program the PLC to monitor the opened and closed status of the altitude valve which opens to allow water to flow from Zone 725 system into the reservoir. Valve status will be displayed at SCADA.
 2. Tags and Loops: ZIC-05, ZIO-05.
 3. Interlocks: The valve will operate hydraulically, in response to the water level in the reservoir. There are no PLC or instrument interlocks.
- C. P&ID I-2, Smoke Detectors
1. Overview: The smoke detectors in pump room and electrical room will detect the presence of smoke in case of a fire and send a smoke alarm to the PLC. Program the PLC to monitor the alarm signal, display at the local OIT and convey the alarm to SCADA. Smoke detection will be displayed and alarmed at SCADA.
 2. Tags and Loops: BA-01, BA-02.
 3. SCADA Alarms:
 - a. Smoke detected in pump room
 - b. Smoke detected in electrical room

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D. P&ID I-2, Room Temperatures

1. Overview: The temperature transmitters in pump room and electrical room will send a 4-20mA signal to the PLC proportional to the temperature in the room. Program the PLC to monitor the temperature signal, display at the local OIT and convey it to SCADA. Temperature reading will be displayed and high temperature alarmed at SCADA.
2. Tags and loops: TI-01, TI-02.
3. SCADA Alarms: The SCADA system will monitor the signal received. The City will create set points in SCADA system for temperature alarms and following alarms will be displayed at SCADA:
 - a. Instrument(s) out of range, under range, fail
 - b. Pump room temperature high
 - c. Electrical room temperature high
4. SCADA Set Points:
 - a. Pump room temperature high alarm: 95 deg F
 - b. Electrical room temperature high alarm: 85 deg F

E. P&ID I-2, Door Intrusion Alarms

1. Overview: Each exterior building door, reservoir hatch doors, inlet valve vault access hatch door shall be monitored for opened condition by means of intrusion switches. The intrusion switches shall send an alarm signal to the PLC when they detect opening of the door. Program the PLC to monitor the intrusion alarm signal, display it on the local OIT and convey the alarm signal to SCADA.
2. Tags and loops: ZA-01, ZA-02, ZA-03, ZA-05, ZA-06, ZA-07.
3. SCADA Alarms:
 - a. Pump room East door opened
 - b. Pump room South door opened
 - c. Electrical room door opened
 - d. Altitude valve vault door opened
 - e. Reservoir East hatch door opened

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f. Reservoir West hatch door opened

F. P&ID I-2, PLC Intrusion Alarm

1. Overview: The PLC panel door shall be monitored for opened condition by means of an intrusion switch. The intrusion switch shall send an alarm signal to the PLC when it detects opening of the door. Program the PLC to monitor the intrusion alarm signal, display it on the local OIT and convey the alarm signal to SCADA.
2. Tags and loops: ZA-04.
3. SCADA Alarms: PLC panel door opened.

G. P&ID I-2, Reservoir Level

1. Overview: The La Jolla Country Club Reservoir shall be equipped with an ultrasonic level transmitter which shall monitor the water level in the reservoir and send a proportional 4-20mA signal to the PLC. The PLC shall be programmed to monitor, trend the level signal, display at the local OIT and convey the signal to SCADA. The level signal will be monitored at the SCADA system and compared with City provided level set points to generate high level, low level and low-low level alarms.
2. The reservoir shall also be equipped with a level detection switch which will be installed to actuate when a pre-determined high water level is reached in the reservoir. The level switch shall be monitored by the PLC and a high level alarm signal generated when the high level switch actuates. This alarm shall be displayed at the local OIT, and conveyed to SCADA.
3. Additionally, the pressure transmitter installed at the inlet of the pump station will also provide reservoir level measurement as a back-up. See loop Pressure Monitoring for details.
4. Tags and loops: LI-01, LA-01.
5. SCADA Alarms:
 - a. Instrument out of range, under range, fail
 - b. Reservoir level Low-Low
 - c. Reservoir level Low
 - d. Reservoir level High
 - e. Reservoir level High alarm

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6. SCADA Set Points:
 - a. Reservoir level Low-Low: 12 inches from the Reservoir floor
 - b. Reservoir level Low: 24 inches from the Reservoir floor
 - c. Reservoir level High: 15.25 feet from the Reservoir floor
 - d. Reservoir level High alarm: 15.75 feet from the Reservoir floor

H. P&ID I-2, Reservoir Mixing System (Pump)

1. Overview: The reservoir mixing system pump (pump) installed at the top of the reservoir shall provide a sample of reservoir water for residual analysis as well as have the capability to mix the contents of reservoir. HAND-OFF-AUTO control shall be provided for the pump at a starter in the local control panel (LCP) supplied as part of the Reservoir Mixing System. When the operator wants to get a sample, the operator will need to open the manual valve at the end of the reservoir, let the water flow for a few minutes and then collect the sample. In AUTO mode, the pump operation will be controlled from the PLC and SCADA system. At the SCADA system, in SCADA MANUAL mode, the operator will be able to operate the pump manually for mixing the reservoir contents, by turning the pump ON and allowing it to run continuously (24 hours per day, 365 days per year). Upon falling level in the reservoir and when LIT-01 reaches the reservoir level medium setpoint, the pump shall turn OFF when in SCADA MANUAL and the LCP hand switch is set to AUTO. No SCADA-AUTO mode.

When the reservoir mixing system LCP hand switch is set to HAND or AUTO, the pump shall turn OFF if the LSL-01 is activated.

Pump control in AUTO, pump RUNNING status and pump FAIL alarm will be conveyed from LCP to the PLC and SCADA system. Pump START and STOP control in AUTO mode shall be provided through the PLC and SCADA system.

Program the PLC to monitor the pump status, accumulate runtime, display status on the local OIT and convey the signals between the pump LCP and SCADA.

2. Tags and loops: YI-04A, YI-04B, HS-04A, HS-04B, YA-04.
3. PLC Special Functions: Program PLC to perform the following operations in AUTO mode:
 - a. START-STOP pump based on control signal from SCADA
4. SCADA Special Functions: Following operation will happen at SCADA:

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- a. In AUTO mode, select SCADA-MANUAL to start the pump manually and stop after a preset time duration, through PLC.
5. SCADA Alarms: Pump Fail.
6. SCADA Set Points:
 - a. Pump run duration in SCADA-MANUAL mode: 24 hours per day
- I. P&ID I-2, Sump Pump
 1. Overview: The sump pump shall be installed in a manhole adjacent to the reservoir to pump the water drained from the reservoir to the sanitary sewer. Additionally, a level detection switch shall be installed in the manhole which shall actuate at a pre-determined high water level in the manhole. HAND-OFF-AUTO control shall be provided for the pump at a starter in the MCC. When the operator wants to manually pump the contents of the manhole, the pump will be operated in HAND mode. In AUTO mode, the pump operation will be controlled from the PLC and SCADA system. At the SCADA system, in SCADA-MANUAL mode, the operator will be able to operate the pump manually for a pre-set period of time or in SCADA-AUTO mode, pump will be automatically operated when the water level in the manhole actuates the level detection switch. PLC shall be programmed to operate the pump until the level falls below the high level actuation point for a preset duration.
 2. Pump control in AUTO, pump RUNNING status and pump FAIL alarm will be conveyed from MCC to the PLC and SCADA system. Pump START and STOP control in AUTO mode shall be provided through the PLC and SCADA system.
 3. Pump motor shall be provided with integral moisture and over temperature detection feature and these will be wired back to the motor starter. The PLC will receive a common FAIL alarm for any fault conditions.
 4. Program the PLC to monitor the pump status, accumulate runtime, display status on the local OIT and convey the signals between the pump starter and SCADA.
 5. Tags and loops: YI-05A, YI-05B, HS-05A, HS-05B, YA-05.
 6. Interlocks:
 - a. Hardwired: None
 - b. Software: Level detection switch with pump operation

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7. PLC Special Functions: Program PLC to perform the following operations in AUTO mode:
 - a. START-STOP pump based on control signal from SCADA
 - b. Program time duration for SCADA-Manual pump operation.
 - c. Program interlock between level detection switch and pump operation in AUTO mode.
 7. SCADA Special Functions: Following operation will happen at SCADA:
 - a. In AUTO mode, select SCADA-MANUAL to start the pump manually and stop after a preset time duration, through PLC.
 - b. In AUTO mode, select SCADA-AUTO to start and stop the pump through PLC, when the sump level is higher than the level detection switch actuation level.
 8. SCADA Alarms:
 - a. Pump Fail
 - b. Sump Level High
 9. SCADA Set Points: Pump run duration in SCADA-MANUAL mode: Operator adjustable between 0 and 24 hours.
- J. P&ID I-3, Booster Pump Station
1. Overview: Three booster pumps shall be installed in the pump room each with a suction valve, local disconnect switch, discharge pressure switch, discharge control valve (PCV), and an E-STOP switch. Two (2) booster pumps shall be operated by Variable Frequency Drives (VFD) and one (1) booster pump shall be operated by a constant speed Reduced Voltage Soft Starter (RVSS). The suction side of booster pumps shall be connected to common suction header and the site 725 reservoir. Discharge side of booster pumps shall be connected to common distribution header and pressurized 925 zone.
 2. Booster pumps shall be operated in a LEAD-LAG1-LAG2 configuration. Variable speed booster pumps will be designated and operated as Lead and Lag1. Constant speed booster pump will designated and operated as the LAG2 pump.
 3. Program PLC to sequence and adjust speed of Lead and Lag1 booster pumps to meet flow demands and maintain discharge line pressure set-points. Program PLC to operate Lag 1 booster pump in the event Lead pump is not able to maintain system pressure and flow demand

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(i.e. pump operating at 100 percent speed for a pre-set adjustable period of time) or in the event of a Lead booster pump FAIL condition. During dual pump operation, PLC shall shutdown Lead booster pump in the event both Lead and Lag1 booster pumps are operating at minimum speed for a pre-set adjustable period of time. During single booster pump operation, PLC shall shutdown operating pump in the event the pump is operating at minimum speed for a pre-set adjustable period of time.

4. PLC shall operate Lag2 booster pump in the event Lead and Lag1 booster pump are not able to maintain system pressure and flow demand (i.e. both pumps operating at 100% speed for a pre-set adjustable period of time) or in the event of a Lead or Lag 1 booster pump FAIL condition.
5. A pressure sustaining valve (PSV) shall be installed in the bypass line from the discharge header to the reservoir to open in the event the demand is lower than the low capacity of the operating booster pump while sustaining the pressure upstream of the PSV.
6. During Constant Speed Booster Pump operation, PLC shall automatically reduce speed of Lead-Lag1 Booster pumps. In the event that both Lead and Lag 1 booster pumps reach minimum speed for a pre-set adjustable period of time, the PLC shall shutdown the Lag 2 booster pump. In the event the speed of the Lead and Lag1 booster pump reaches minimum speed for a pre-set adjustable period of time, the PLC shall shutdown the Lead booster pump. In the event the speed of the Lag1 booster pump reaches minimum speed for a pre-set adjustable period of time, the PLC shall shutdown the Lag1 booster pump. In the event the Lag1 booster pump remains in operation at minimum speed and PSV remains OPEN (bypassing flow) for a pre-set adjustable period of time, PLC shall shutdown all booster pumps and allow the PLC to recommence Lead-Lag1-Lag2 sequence of operation.
7. HAND and AUTO Mode of Operation:
 - a. Each booster pump VFD or RVSS shall have a HAND-OFF-AUTO (HOA) selector switch, momentary START, STOP, and RESET push buttons, elapsed time meter, indicator for running status and indicators for pressure, temperature, fail alarms. An EMERGENCY STOP mushroom head type maintained contact push button shall be located adjacent to each booster pump for local SHUTDOWN operation. Lead-Lag1 booster pumps shall incorporate Human Interface Module (HIM) in the VFD enclosures allowing for local speed adjustment.
 - b. With the HOA selector switch in the HAND position and the START push button at the motor control activated, the

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- booster pump shall be allowed to start if there are no faults or alarm conditions present. The booster pump shall stop when the STOP push button is activated.
- c. 10 In HAND mode Lead-Lag 1 booster pumps SPEED will be entered by operator at the respective HIM.
 - d. With the HOA selector switch in the AUTO position, booster pump operation shall be controlled by the PLC and SCADA.
 - e. In either of these modes of operation, the booster pump shall STOP if the HOA selector switch is placed in the OFF position or if the EMERGENCY STOP (E-STOP) push button is activated. The booster pump shall be stopped during low and high pressure, fault (overload, phase voltage unbalance, under voltage, control power fail and other settable parameters within the VFD and the RVSS), and motor winding Over Temperature conditions.
 - f. In the event of a booster pump failure, PLC will operate the next designated booster pump selected to AUTO.
8. VFDs shall be programmed with a minimum booster pump speed to prevent the overheating of booster pump motors.
 9. The suction valve shall be manual and always open. Valve OPEN status shall be hardwired to the VFD or RVSS to inhibit pump operation if the suction valve is not open.
 10. Pump control in AUTO, pump RUNNING status, pump inlet valve OPENED, pump discharge valve OPENED, CLOSED status will be conveyed from the VFD or RVSS to the SCADA system. SCADA alarms shall be as outlined below. Pump START and STOP control in AUTO mode, SPEED INDICATION and CONTROL for VFD driven pumps shall be provided through the PLC and SCADA system.
 11. Program the PLC to monitor the pump status, accumulate runtime, provide Lead-Lag1-Lag2 operation as described above, display status, on the local OIT and convey the signals between the pump VFD and RVSS and SCADA.
 12. Booster Pump Discharge Control Valves:
 - a. Booster Pump discharge control valves (PCVs) will be hardwired with pump motor control. Booster pump will start and operate against a closed valve (i.e. discharge control valve will open in response to pump operation). During Booster Pump called to stop operation, discharge control valve will close prior to pump shutdown. Program PLC to monitor valve opened and closed status, display on local OIT and convey to the SCADA system.

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13. Tags and loops:
 - a. P-01 (Lead Pump): ZIO-01A, YI-01A, YI-01B, HS-01A, HS-01B, ZIC-01B, ZIO-01B, TA-01, YA-01A, YA-01B, PA-01, SHK-01, SI-01; XI-01
 - b. P-02 (Lag Pump 1): ZIO-02A, YI-02A, YI-02B, HS-02A, HS-02B, ZIC-02B, ZIO-02B, TA-02, YA-02A, YA-02B, PA-02, SHK-02, SI-02; XI-02
 - c. P-02 (Lag Pump 2): ZIO-03A, YI-03A, YI-03B, HS-03A, HS-03B, ZIC-03B, ZIO-03B, TA-03, YA-03A, YA-03B, PA-03; XI-03
14. Interlocks:
 - a. Hardwired: Pump operation with local disconnect, suction inlet valve position switch, discharge pressure switch, E-Stop switch, motor temperature switch, discharge control valve status
 - b. Software: As described above under Lead-Lag1-Lag2 operation
15. PLC Special Functions: Program PLC to perform the following operations in AUTO mode:
 - a. START-STOP pump based on control signal from SCADA
 - b. Control VFD speed based on control signal from SCADA
 - c. Program interlocks for Lead-Lag1-Lag2 pump operation
16. SCADA Special Functions: Following operation will happen at SCADA:
 - a. In AUTO mode, select SCADA-MANUAL to start the pump manually, through PLC.
 - b. In AUTO mode, select SCADA-AUTO to start and stop the pump through PLC, in response to Lead-Lag1, Lag2 sequence of operation.
17. SCADA Alarms: Alarms below are typical for three (3) pumps:
 - a. Suction pressure Low
 - b. Motor temperature High
 - c. Control Power Fail
 - d. Discharge pressure high

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- e. Pump Fail
18. SCADA Set Points:
- a. Lead pump operation at 100% speed before Lag1 pump should start: 30 seconds
 - b. Shutdown of Lead pump when both Lead and Lag1 booster pumps are operating at minimum speed for a duration of: 30 seconds
 - c. Shutdown of operating pump when operating at minimum speed for a duration of: 30 seconds
 - d. Start of Lag2 pump when Lead and Lag1 booster pumps are not able to maintain system pressure and flow demand (i.e. both pumps operating at 100% speed) for a duration of: 30 seconds
 - e. Shut down of all pumps when Lag2 pump remains in operation and pressure sustaining valve remains OPEN (bypassing flow) for a duration of: 5 minutes
 - f. Shut down of running pump(s) when suction pressure remains low for a duration of: 30 seconds
- K. P&ID I-3, Pressure Sustaining Valve
- 1. Overview: CONTRACTOR shall program the PLC to monitor the opened and closed status of the pressure sustaining valve which opens to allow water pressure relief from the discharge header to the reservoir. The valve will operate hydraulically, in response to a water pressure surge in the discharge manifold, which may occur during booster pump(s) turning on and off . Valve status will be displayed at SCADA.
 - 2. Tags and Loops: ZIC-04, ZIO-04.
 - 3. Interlocks: The valve will operate hydraulically, in response to the water pressure in the discharge header. There are no PLC or instrument interlocks.
- L. P&ID I-3, Pump Room Flood
- 1. Overview: A flood level detection switch shall be provided in the pump room to monitor the sump level. The switch shall send an alarm signal to the PLC when it detects higher water level than its actuation level. Program the PLC to monitor the flood alarm signal, display it on the local OIT and convey the alarm signal to SCADA.

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2. Tags and loops: LA-02.
 3. SCADA Alarms: Pump room flood.
- M. P&ID I-3, MCC Power, Utility Or Generator Mode
1. Overview: The Power On signal shall be monitored by a relay in the MCC and conveyed to the PLC. Program PLC for conveying an alarm to SCADA system when it detects termination of Power ON signal at MCC. Additionally, relays in the MCC shall monitor the power being fed from Utility or Generator. The ON status of each source shall be displayed at the local OIT and conveyed to the SCADA system.
 2. Tags and loops: JA-01, JI-01, JI-02, JI-03, JI-04, JI-01A, JI-01B.
 3. SCADA Alarms: MCC power fail
- N. P&ID I-3, Pressure Monitoring
1. Overview: The pump station suction and discharge pipe headers shall be provided with pressure transmitters which will send a 4-20mA signal proportional to the pressure to the PLC. Program the PLC to monitor the pressure signals, display at the local OIT and convey it to SCADA. Pressure readings will be displayed and alarmed at SCADA.
 2. The 4-20mA signal from the suction pressure transmitter shall also be scaled to display reservoir level at the OIT and SCADA. This shall serve as a back up to the ultrasonic level reservoir level measurement. PLC shall be programmed to switch to level measurement through the pressure transmitter in the event of failure of the ultrasonic level measurement.
 3. Tags and loops: PI-01, PI-02.
 4. SCADA Alarms: The SCADA system will monitor the signal received. The City will create set points in SCADA system for pressure alarms and following alarms will be displayed at SCADA:
 - a. Instrument(s) out of range, under range, fail
 - b. Suction Pressure low
 - c. Discharge Pressure high
 5. SCADA Set Points:
 - a. Discharge pressure high alarm: 108 psi
 - b. Suction pressure low alarm: 1psi

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- O. P&ID I-3, Flow Monitoring
 - 1. Overview: The pump station discharge pipe header shall be provided with a flow transmitter which will send a 4-20mA signal, proportional to the flow, to the PLC. Additionally, the flow transmitter shall send a pulse signal to the PLC in order to totalize the measured flow. Program the PLC to monitor the flow signal, calculate flow totals, display flow signal and totals at the local OIT and convey it to SCADA.
 - 2. Tags and loops: FI-01, FQI-01.
 - 3. SCADA Alarms: The SCADA system will monitor the signals received. The following alarms will be displayed at SCADA:
 - a. Instrument(s) out of range, under range, fail
- P. P&ID I-3, PLC Panel Battery Power
 - 1. Overview: The battery system provided inside the PLC panel shall be monitored by relays for low battery voltage and battery ON status in case of utility power failure. These shall be conveyed to the PLC, program PLC to convey an alarm when it detects low battery voltage and a Battery ON status to the SCADA system, and display on local OIT.
 - 2. Tags and loops: EJA-01, YI-01.
 - 3. SCADA Alarms: PLC battery low voltage.
- Q. P&ID I-4, Power Monitoring
 - 1. Overview: The utility power monitor in the MCC as well as the power monitoring unit at each VFD and RVSS shall be monitored by the PLC and SCADA system for the following signals via Modbus over Ethernet:
 - a. MCC voltage (each phase)
 - b. MCC current (each phase)
 - c. MCC real Power (KW)
 - d. MCC reactive Power (KVAR)
 - e. MCC power factor
 - f. Pump voltage (each phase)
 - g. Pump current (each phase)
 - h. Pump real power (KW)

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- i. Pump reactive power (KVARs)
 - j. Pump power factor
2. Tags and loops: JI-01, JI-02, JI-03, JI-04

2.3 PLC AND SCADA STANDARD FUNCTIONS

- A. Perform network communications and transfer of data between PLC, VFDs, RVSS, motor starters and OIT.
- B. Perform network communications and transfer of data between PLC and SCADA system.
- C. Generate EQUIPMENT FAIL TO START and EQUIPMENT FAIL TO STOP alarms.
- D. Perform equipment stagger start after utility power FAIL and return to standby generator or utility power operations.
- E. Remove start, open, close commands from failed equipment.
- F. Lock out equipment that fails. Inhibit operation of failed equipment in Auto mode, until operator Resets the PLC by switching the equipment from Auto to Off and back to Auto.
- G. In Auto mode, inhibit motor start operation until after one (1) minute elapses following the stop command, in order to allow the motor to come to a complete stop before starting again.
- H. Monitor, scale, display process variables such as level, flow, temperature, pressure.
- I. Perform process totals including flow totals, equipment runtimes and equipment number of starts.
- J. Perform instrument Out-of-Range, Under-Range monitoring and alarm.
- K. Monitor and display at SCADA, equipment status, controls, alarms and trends.
- L. Operate equipment in SCADA-Manual and SCADA-Auto modes of operation.
- M. Adjust process and alarm set points in response to changes made at SCADA.

2.4 INPUT/OUTPUT SUMMARY

- A. General: The Input/Output Summary presented at the end of this Section itemizes all inputs and outputs for the I&C system.
- B. Content: Each column on the I/O summary is defined as follows:

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1. Tag Number: The identifier assigned to a device which performs a function in the control system.
2. Loop Number: The number assigned to the control loop associated with the I/O.
3. Description: A process-oriented functional description that defines the measured, monitored or controlled parameter and the associated process/process equipment.
4. P&ID Number: The P&ID drawing number upon which the device appears.
5. Specification Section: The Specification Section associated with each instrument.
6. I/O Classification: The type of I/O required for current and future monitoring and control activities (spare I/O is not included).
 - a. I/O type (analog, discrete, digital link, etc.)
 - b. Total number of digital input, digital output, analog input and analog output points associated with the PLC, including 20% spare I/O.

2.5 INSTRUMENT SUMMARY

- A. General: The Instrument Summary presented at the end of this Section itemizes all required instruments for the Project.
- B. Content: Each column on the Instrument Summary is defined as follows:
 1. Instrument tag and loop number
 2. Description indicating type of instrument
 3. P&ID Number
 4. Installation detail number for the instrument
 5. Specification section number
 6. Instrument range
 7. Calibrated span
 8. Instrument setpoints
 9. NEMA rating

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10. Material requirements

PART 3 – EXECUTION

3.1 I/O LIST

TAG #	LOOP #	DESCRIPTIONS	P&ID	SPECIFICATION	I/O TYPE			
					DI	DO	AI	AO
PI	01	SUCTION PRESS	I-3	13334			X	
LA	02	PUMP RM SUMP FLOOD	I-3	13325	X			
EJA	01	PLC BATTERY LOW	I-3	13374	X			
YI	01	PLC BATTERY ON	I-3	13374	X			
JA	01	MCC POWER FAIL	I-3	16480	X			
Jl	01A	MCC POWER FROM UTILITY ON	I-3	16480	X			
Jl	01B	MCC POWER FROM GEN ON	I-3	16480	X			
ZIO	01A	P-01 INLET VALVE OPEN	I-3	13335	X			
YI	01A	P-01 IN AUTO	I-3	16480	X			
YI	01B	P-01 RUNNING	I-3	16480	X			
HS	01A	P-01 START COMMAND	I-3	16480		X		
HS	01B	P-01 STOP COMMAND	I-3	16480		X		
ZIC	01B	PCV-01 CLOSED	I-3	16480	X			
ZIO	01B	PCV-01 OPENED	I-3	16480	X			
TA	01	P-01 HIGH TEMP	I-3	16480	X			
YA	01A	P-01 CONTROL POWER FAIL	I-3	16480	X			
PA	01	P-01 PRESS HIGH	I-3	16480	X			
YA	01B	P-01 FAIL	I-3	16480	X			
SHK	01	P-01 SPEED CONTROL	I-3	16480				X
SI	01	P-01 SPEED	I-3	16480			X	
ZIO	02A	P-02 INLET VALVE OPEN	I-3	13335	X			
YI	02A	P-02 IN AUTO	I-3	16480	X			
YI	02B	P-02 RUNNING	I-3	16480	X			
HS	02A	P-02 START COMMAND	I-3	16480		X		
HS	02B	P-02 STOP COMMAND	I-3	16480		X		
ZIC	02B	PCV-02 CLOSED	I-3	16480	X			
ZIO	02B	PCV-02 OPENED	I-3	16480	X			

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TAG #	LOOP #	DESCRIPTIONS	P&ID	SPECIFICATION	I/O TYPE			
TA	02	P-02 HIGH TEMP	I-3	16480	X			
YA	02A	P-02 CONTROL POWER FAIL	I-3	16480	X			
PA	02	P-02 PRESS HIGH	I-3	16480	X			
YA	02B	P-02 FAIL	I-3	16480	X			
SHK	02	P-02 SPEED CONTROL	I-3	16480				X
SI	02	P-02 SPEED	I-3	16480			X	
ZIO	03A	P-03 INLET VALVE OPEN	I-3	16480	X			
YI	03A	P-03 IN AUTO	I-3	16480	X			
YI	03B	P-03 RUNNING	I-3	16480	X			
HS	03A	P-03 START COMMAND	I-3	16480		X		
HS	03B	P-03 STOP COMMAND	I-3	16480		X		
ZIC	03B	PCV-03 CLOSED	I-3	16480	X			
ZIO	03B	PCV-03 OPENED	I-3	16480	X			
TA	03	P-03 HIGH TEMP	I-3	16480	X			
YA	03A	P-03 CONTROL POWER FAIL	I-3	16480	X			
PA	03	P-03 PRESS HIGH	I-3	16480	X			
YA	03B	P-03 FAIL	I-3	16480	X			
PI	02	DISCHARGE PRESSURE	I-3	13334			X	
ZIC	04	PSV-01 CLOSED	I-3		X			
ZIO	04	PSV-01 OPENED	I-3		X			
FI	01	PUMP STATION DISCHARGE FLOW	I-3	13314			X	
BA	01	SMOKE DETECTED	I-2		X			
BA	02	SMOKE DETECTED	I-2		X			
TI	01	PUMP RM TEMP	I-2	13344			X	
TI	02	ELECT RM TEMP	I-2	13344			X	
ZA	01	PUMP RM E. DOOR OPEN	I-2		X			
ZA	02	PUMP RM S. DOOR OPEN	I-2		X			
ZA	03	ELECT RM DOOR OPEN	I-2		X			
ZA	04	PLC PANEL DOOR OPEN	I-2	13374	X			
ZIC	05	AV-01 CLOSED	I-2		X			
ZIO	05	AV-01 OPENED	I-2		X			
ZA	05	INLET VAULT DOOR OPEN	I-2		X			

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3.2 INSTRUMENT LIST

TAG-LOOP#	DESCRIPTION	P&ID	INSTALLATION DETAIL #	SPEC SECTION	RANGE	SET POINTS	COMMENTS
BS-01	SMOKE DETECTOR	I-2	-	13300	-	-	Alarm
BS-02	SMOKE DETECTOR	I-2	-	13300	-	-	Alarm
TIT-01	TEMP TRANSMITTER	I-2	-	13344	0-120 F	105°F	Alarm
TIT-02	TEMP TRANSMITTER	I-2	-	13344	0-120 F	100°F	Alarm
ZS-01	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
ZS-02	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
ZS-03	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
ZS-04	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
ZS-05	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
LSH-01	LEVEL DETECTION SWITCH	I-2	CIP I-615	13325	-	Set at El 726	-
LSL-01	LEVEL DETECTION SWITCH	I-2	CIP-I-615	13325	-	Set at El 713	-
LE/LIT-01	LEVEL TRANSMITTER	I-2	CIP I-601, I-602	13324	0-20 feet	Various	See paragraph 2.2.G.6 in this section
ZS-06	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
ZS-07	INTRUSION SWITCH	I-2	-	13300	-	-	Alarm when open
LSH-05	LEVEL DETECTION FLOOD SWITCH	I-2	CIP I-616	13325	-	-	-
PI-05	PRESSURE GAUGE	I-2	CIP I-608	13334	0-15psi	-	-
PIT-01	PRESSURE TRANSMITTER	I-3	CIP I-605	13334	0-15psi	1 psi	Shut off operating booster pumps
LSH-02	LEVEL DETECTION FLOOD SWITCH	I-3	CIP I-616	13325	-	-	-
PSH-01	PRESSURE SWITCH	I-3	CIP I608	13335	0-150 psi	108 psi	Shut pump off

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TAG- LOOP#	DESCRIPTION	P&ID	INSTALLATION DETAIL #	SPEC SECTION	RANGE	SET POINTS	COMMENTS
PI-01A	PRESSURE GAUGE	I-3	CIP I-608	13334	0-15psi		
PI-01B	PRESSURE GAUGE	I-3	CIP I-608	13334	0-160psi		
PSH-02	PRESSURE SWITCH	I-3	CIP I-608	13335	0-160 psi	108 psi	Shut pump off
PI-02A	PRESSURE GAUGE	I-3	CIP I-608	13334	0-15psi	-	-
PI-02B	PRESSURE GAUGE	I-3	CIP I-608	13334	0-160psi	-	-
PSH-03	PRESSURE SWITCH	I-3	CIP I-608	13335	-	108 psi	Shut pump off
PI-03A	PRESSURE GAUGE	I-3	CIP I-608	13334	0-15psi		
PI-03B	PRESSURE GAUGE	I-3	CIP I-608	13334	0-160psi		
PIT-02	PRESSURE TRANSMITTER	I-3	CIP I-605	13334	0-1150psi	108 psi	Alarm
FE/FQIT -01	FLOW TRANSMITTER	I-3	CIP I-604	13314	0-4800 gpm	-	Indication only

****END OF SECTION****

SECTION 13314 – IN-LINE FLOW MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide in-line liquid flow measuring systems, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 09800 Protective Coating
3. Section 13300 Instrumentation and Control
4. Section 15000 Piping Components

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. ANSI/NCSL-2540-1 Calibration Laboratory and Measuring and Test Equipment General Requirements
2. ANSI B16.5 Pipe Fittings and Flanged Fittings, NPS 1/2 through NPS 24
3. ANSI/AWWA C207 Steel Pipe Flanges for Waterworks
4. ASTM B61 Specification for Steam or Valve Bronze Castings

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings shall conform with the requirements of Section 01300 - Submittals, Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

PART 2 -- PRODUCTS

2.1 MAGNETIC FLOW MEASURING SYSTEMS

- A. Magnetic flow measuring systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly

SECTION 13314 – IN-LINE FLOW MEASURING SYSTEMS

proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter, and flowmeter grounding rings.

1. The metering tube shall have the following attributes:
 - a. Constructed of Type 304 stainless steel with flanged connections.
 - b. Liner in conformance with the manufacturer's recommendation for potable water.
 - c. Electrodes constructed of materials which are in conformance with the manufacturer's recommendation for potable water.
 - d. Meter housing rated for NEMA 6 submergence conditions.
 - e. Meter coating consisting of epoxy paint finish.
 - f. Two grounding rings that conform with the manufacturer's bore and material recommendation for the intended service. Grounding rings shall be designed to protect and shield from abrasion the liner edge interface at the meter end.
2. The microprocessor-based signal converter/transmitter shall have the following attributes:
 - a. Use DC pulse technique to drive flux-producing coils.
 - b. Convert DC pulse signal from the tube to a standardized 4-20 mA signal into a minimum of 700 ohms.
 - c. A 6 digit LCD display for flow rate, percent of span, and totalizer.
 - d. An operator interface consisting of keypads which respond to English text entry.
 - e. Integral zero return to provide a consistent zero output signal in response to an external dry contact closure.
 - f. Integral low flow cutoff and zero return.
 - g. Automatic range change.
 - h. Capable of measuring flow in both directions.

SECTION 13314 – IN-LINE FLOW MEASURING SYSTEMS

- i. Programmable parameters including meter size, full scale Q, magnetic field frequency, primary constant, time constant.
 - j. Data retention for a minimum of 5 years without auxiliary power (main or battery).
 - k. Self diagnostics and automatic data checking.
 - l. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.
 - m. Use "Smart" technology which employs a hand-held configuration terminal and outputs a digital flow signal superimposed on 4-20 mA signal and complies to HART protocol.
 - n. Produce a scaleable frequency output, 0 to 100 Hz, transistor switch closure up to 5.75 W externally powered, 5 to 24 VDC.
 - o. Tolerate ambient temperature operating limits of -20 to +140 degrees F.
- B. Calibration: Each magnetic flowmeter system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technologies. The calibrations procedure shall conform to the requirements of ANSI/NCSL-2540-1. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20, 40, 60, 80 and 100% of the calibrated range shall be submitted to the RESIDENT ENGINEER at least 30 days before shipment of the meters to the project site.
- C. Performance: The flow metering system shall conform to the following requirements:
- 1. Time constant = 0.5 to 1000 seconds; galvanic or optic isolation.
 - 2. Accuracy: 0.5% of flow rate from 1 ft/sec to 33 ft/sec.
 - 3. Repeatability: 0.25% full scale.
 - 4. Power consumption: 30 watts or less.
 - 5. Power Requirements: 120 VAC, ±10%.
- D. The following magnetic flow measuring systems shall be provided:

Tag			Liner	Electrode	NEMA Rating
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SECTION 13314 – IN-LINE FLOW MEASURING SYSTEMS

No.	Size	Range	Material	Material	Body/Transmitter
FE/FQIT-01	8"	0-4800 gpm	(A)	(A)	NEMA 6

(A) NOTE: Liner/Electrode Material to be provided per manufacturer recommendations

- E. Manufacturers, or equal:
1. Endress & Hauser; ProMag (Drinking Water Certified).
 2. Emerson; Model 8705 (Drinking Water Certified).
 3. Siemens; Sitrans Mag Flo Series (Drinking Water Certified).

PART 3 -- EXECUTION

- A. In-line flow measuring systems shall be executed according to Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

**** END OF SECTION ****

SECTION 13324 – LEVEL MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all level detection switches, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 1. Section 01300 Submittals
 2. Section 13300 Instrumentation and Control
 3. Section 13325 Level Detection Switches

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The requirements of Section 13300 - Instrumentation and Control apply to all the products indicated herein.

2.2 LEVEL MEASURING SYSTEM

- A. Level measuring system shall consist of an ultrasonic level sensor with integral transmitter. The transmitter shall be a 2-wire loop powered instrument measuring process liquid level and producing a 4-20mA signal proportional to the measured level. The accuracy shall be ± 0.15 percent of range or 0.24 inch, whichever is greater. The transmitter shall have in-built temperature compensation, a repeatability of 0.12 inch, blanking distance of 10 inches and a beam angle of 10 degrees. It shall be suitable for potable water application and an ambient temperature range of minus 40 degree F to plus 175 degree F. The process connection shall be 2 inch NPT flanged connection at reservoir. Local display shall be LCD type and transmitter shall be HART compatible.
- B. Level measuring transmitter shall be SIEMENS Sitrans L Probe LU, or equal.

SECTION 13324 – LEVEL MEASURING SYSTEMS

PART 3 -- EXECUTION

3.1 GENERAL

- A. Execution of level measuring system shall conform to the requirements of Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13325 – LEVEL DETECTION SWITCHES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all level detection switches, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 13300 Instrumentation and Control
 - 3. Section 13324 Level Measuring Systems

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The requirements of Section 13300 - Instrumentation and Control apply to all the products indicated herein.

2.2 NON MERCURY FLOAT LEVEL SWITCHES

- A. Float level switches shall consist of a non-mercury snap-action switch, a plastic float housing and a connecting cable which is anchored at the midpoint of a differential band. As the level rises and falls the float rights itself or inverts causing switching actions. The cable anchoring point shall be protected by strain relief. The hermetically sealed switch shall be SPDT with a minimum rating of 10 A at 120 VAC.
- B. Non-mercury float level switches shall be Anchor Scientific, Eco-float or equal.

2.3 LEVEL DETECTION FLOOD SWITCH

- A. Flood switch shall sense presence of water at a preset level in a containment area and actuate a stem type switch. It shall consist of a float, stem, cage, and guide tube connected to a switch enclosure. The mounting hardware shall be type 316 stainless steel and float shall be of Buna-N material. The switch shall be SPDT reed type with contacts rated at 0.5Amp at 120 VAC.

SECTION 13325 – LEVEL DETECTION SWITCHES

- B. Flood switch shall be Gems, model LS-1700 or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Execution of level detection switches shall conform to the requirements of Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13334 – PRESSURE MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR, through the Instrumentation Supplier, shall provide pressure measuring systems, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 13300 Instrumentation and Controls
3. Section 13335 Pressure Detection Switches
4. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Electrical interface and code compliance shall conform to the requirements of Section 13300 - Instrumentation and Control.

2.2 ELECTRONIC PRESSURE TRANSMITTERS

- A. Pressure transmitters shall consist of a 1/2-inch female NPT flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, NEMA 4, and conduit connections. Pressure applied to the transmitter shall be transmitted by a sealed silicone fluid sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes of a capacitor respectively. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change. The amplifier unit shall convert the change in capacitance to a 4-20 mA DC signal, wire type, with an allowable loop load of no less than 600 ohms. Static pressure rating shall be 2,000 psig. The maximum overrange pressure limit shall be a minimum of 150 percent of the minimum range. Span shall be adjustable over a minimum of 100:1 range: External adjustments shall include zero and span.

SECTION 13334 – PRESSURE MEASURING SYSTEMS

Damping shall be provided as an internal adjustment. All equipment shall be suitable for an ambient operating range of -40 to + 175 degrees F. All wetted parts shall be constructed of Type 316 stainless steel. Hardware will be Type 316 stainless steel, wetted O-Rings shall be glass filled TFE, graphite filled PTFE or Viton. The integral indicator shall be calibrated in process units. Power supply shall be 24 VDC. Accuracy, including linearity and repeatability, shall be a plus or minus 0.075 percent of calibrated span. Transmitter shall comply to HART standard data and communication protocol.

- a. Provide stainless steel valve manifold.
- b. Pressure transmitters shall be SMAR; Model LD30XM, no exceptions.

2.3. PRESSURE GAUGES

- A. Pressure gauges shall be Bourdon tube element type for local pressure indication. Gauges shall be 4-3/4 inch dial, white face with black scale and thermoplastic case. Accuracy shall be within 0.5 percent of span. Gauge shall be surface or pipe stand mounted. Gauge shall be glycerine filled with a Type 316 stainless steel element. All gauges shall be provided with isolation valves and throttling device suitable for the intended service.
- B. Gauges shall be as follows:
 - a. Ashcroft; Duragauge model 1259
 - b. Solfrunt; model 19XX, 1981 Advantage
 - c. WIKA, model 2XX.34

PART 3 -- EXECUTION

3.1 GENERAL

- A. Installation of pressure measuring systems shall be in accordance with the requirements of Section 13300 - Instrumentation and Control and Section 15000 - Piping Components.

**** END OF SECTION ****

SECTION 13335 – PRESSURE DETECTION SWITCHES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pressure detection switches, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 13300 Instrumentation and Controls
3. Section 13334 Pressure Measuring Systems
4. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Controls.

PART 2 -- PRODUCTS

2.1 PRESSURE DETECTION SWITCHES

- A. Pressure switches shall be diaphragm actuated. Switch provided with two 3/4-inch conduit connections. Process connection shall be 1/4 inch NPT female nickel plated brass connection. Switch assembly housing shall be cast aluminum rated types 4 per NEMA ICS6. Acutator seal material shall be Buna-N with an operating temperature range of 0 to 150 degree F. CONTRACTOR shall select pressure transducer so that set point falls between 30 and 70 percent of range. Approximate set point and, if applicable, reset point indicated on calibrated scales. Repeatability and sensitivity shall be 1.0 percent of operating range. Contact shall be SPDT type, rated for 10 amps at 120 VAC. Unless otherwise specified, switches nonadjustable deadband type.
- B. Pressure switch shall be Ashcroft; Type 400B series, United Electric type 400 series or equal.

PART 3 -- EXECUTION

3.1 GENERAL

SECTION 13335 – PRESSURE DETECTION SWITCHES

- A. Installation of pressure detection switches shall be according to Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13344 – TEMPERATURE MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide temperature measuring systems, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 13300 Instrumentation and Controls
 - 3. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Controls.

PART 2 -- PRODUCTS

2.1 TEMPERATURE MEASURING SYSTEMS

- A. Temperature transmitter shall be a wall surface mounting, indicating, filled system unit in a suitable enclosure. It shall be resistance temperature detectors (RTD) type to measure the ambient air temperature and transmit a 4-20 mA DC output signal proportional to the temperature. (RTDs) shall be 100 ohms nominal at 0 degrees C, tip-sensitive, three-wire platinum in 0.25-inch Type 316 stainless steel sheath with watertight potting. Sensor accuracy shall be +0.5 degree F or +0.25 percent of reading, whichever is greater. RTDs shall be provided with Type 316 stainless steel thermowell, spring-loading device, extensions, union coupler and explosion-proof aluminum connection head. Union shall extend out beyond pipe lagging.
- B. Transmitter shall be suitable for ambient temperature of minus 20 degrees F to 158 degrees F with display. The transmitter shall be two-wire type with remote power supply. Transmitter shall have a digital accuracy of +0.09 degree F or +0.01 percent of span, whichever is greater. Response time shall be 1.2 second with minimum damping. The indicator shall be three-line LCD type, with failsafe mode, automatic reference junction compensation. The enclosure shall be epoxy coated NEMA 4X, low copper aluminum type. The transmitter shall be suitable for HART communication.

SECTION 13344 – TEMPERATURE MEASURING SYSTEMS

- C. Manufacturers:
 - 1. Invensys/Foxboro; RTT20 Series Transmitter with PR Series RTD and T-Series Thermowell
 - 2. Rosemount; 78 Series Platinum RTD with Thermowell and Model 644H Transmitter

PART 3 -- EXECUTION

3.1 GENERAL

- A. Temperature measuring systems shall be executed according to Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 13370 – CONTROL PANELS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide control panels, complete and operable, in accordance with the CONTRACT DOCUMENTS.
- B. The provisions of this Section apply to local control panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work:
 - 1. Section 01300 Submittals
 - 2. Section 09800 Protective Coatin
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 13300 Instrumentation and Control
 - 5. Section 13374 Control Panel Instrumentation
 - 6. Section 16480 Motor Control Center

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:
 - 1. ASTM A36 Specification for Carbon Structural Steel
 - 2. ASTM A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 - 3. NEMA ICS-1-101 Industrial Control Systems
 - 4. SSPC-SP6 Specification for the Society for Protective Coating B Commercial Blast

1.4 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Section 01300 - Submittals and Section 13300 - Instrumentation and Control.

SECTION 13370 – CONTROL PANELS

- B. Control Panel Engineering Submittal: The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 13. The CPES shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation and SCADA system components, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. All panel drawings shall be "B" size, and all data sheets and manufacturer specification sheets shall be "A" size. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, shall be submitted as a singular complete bound volume or multi-volume package within 120 calendar days after Notice to Proceed and shall have the following content:
1. A complete index shall appear in the front of each bound volume. Panels shall be indexed by system or process area, and drawings and data associated with a panel shall be grouped together. All panel tagging and nameplate nomenclature shall be consistent with the requirements of the CONTRACT DOCUMENTS.
 2. Scale construction drawings which define and quantify the type and gauge of steel to be used for panel fabrication, the ASTM A36 grade proposed for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details and proposed locations on the use of "Unistrut" members, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations and lifting lug material and locations.
 3. Scale physical arrangement drawings which define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be indicated.
 4. Front of panel layouts for all control panels.
 5. Schematic/elementary diagrams depicting all control devices and circuits and their functions.
 6. Wiring/connection diagrams locating and identifying electrical devices, terminals and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
 7. Interconnection diagrams locating and identifying all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting

SECTION 13370 – CONTROL PANELS

wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

8. Control sequence diagrams to portray the contact positions or connections required to be made for each successive step of the control action. Written descriptions explaining the control sequence diagrams and system operation shall be furnished.
9. Completed ISA-S20 data sheets for all instrumentation devices associated with each control panel, supplemented with manufacturer specification sheets which verify conformance to the requirements of the Contract Documents.
10. A bill of material which enumerates all devices associated with the control panel.
11. A priced listing of analog spare parts in conformance with Section 13300 - Instrumentation and Control.

1.5 SPARE PARTS AND SPECIAL TOOLS

- A. Control panel spare parts selected by the RESIDENT ENGINEER and special tools shall be provided in accordance with Section 13300 - Instrumentation and Control.
- B. All spare parts and special tools shall be submitted before startup commences, suitably wrapped and identified.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Environmental Suitability: All indoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the CONTRACT DOCUMENTS. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices no less than 20% below the maximum rated environmental operating level, and at least 20% above the minimum rated environmental operating level. The CONTRACTOR shall provide all power wiring for these devices. Enclosures suitable for the environment shall be furnished.
- B. The control panel controls shall be 120 VAC. Where the electrical power supply to the control panel is 240 VAC single phase or 480 VAC 3-phase, as indicated, the control panel shall be provided with a control power transformer. Control conductors shall be provided in accordance with the indicated requirements.
- C. The control panel shall be the source of power for any 120-VAC solenoid valves interconnected with the control panel. All equipment associated with the

SECTION 13370 – CONTROL PANELS

control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

- D. The main feeder disconnect shall have a door-mounted handle unless otherwise indicated.
- E. Control panels shall be housed in NEMA 12 enclosures with gasketed doors. Control panels shall be either freestanding pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.
- F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. Provide sufficient terminal blocks to connect 25% additional conductors for future use.
- G. Motor starters, where required, shall be in accordance with Section 16480 - Motor Control Center. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. All electrical components shall be of standard American manufacture.
- H. Discrete outputs from the control panel shall be provided by electrically isolated contacts rated for 5 A at 120 VAC. Analog inputs and outputs shall be an isolated 4-20 mA, 2-wire signals with power supply.
- I. Programmable Logic Controllers (PLCs) may be provided in lieu of relays if the programmable logic controllers match the PLCs provided under Section 13374 - Control Panel Instrumentation.
- J. All control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation. Provide all combination motor starters not furnished in a MCC but indicated in Section 11000 - Equipment General Provisions.
- K. Painting: Control panels shall be thoroughly cleaned and sand blasted per Steel Structures Painting Council Specification SSPC-SP-6 (Commercial Blast) after which surfaces shall receive a prime coat of Amercoat 185 or equal 3-mils dry, for a total thickness of the complete system of 6 mils. The finished color of the outside surfaces shall be selected by the RESIDENT ENGINEER, unless otherwise indicated. The interior of the control panel, back-panel, and side-panel(s) shall have a white finish coat.

2.2 CONTROL PANELS

- A. Materials:

SECTION 13370 – CONTROL PANELS

1. Panel section faces shall be No. 10 gauge minimum thickness steel for free standing panels and No. 14 gauge minimum thickness steel for wall mounted or pedestal mounted panels. All materials shall be selected for levelness and smoothness.
 2. Relay rack high density type panels shall use standard relay racks with No. 14 gauge steel frame and supports.
 3. Structural shapes and strap steel shall comply with ASTM A283.
 - a. Bolting Material: Commercial quality carbon steel bolts, nuts and washers, shall be 2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex head machine bolts. All nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have SAE standard lock washers.
 4. Construction: Dimensions shall be in accordance with vendor's requirements. Elevations and horizontal spacing shall be subject to RESIDENT ENGINEER'S approval.
- B. Fabrication:
1. End plates, top plates and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be provided in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inches wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.
 2. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.
 - a. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.
 - b. The face of the panel shall be true and level after flanging.

SECTION 13370 – CONTROL PANELS

- c. All panel cut-outs and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.
 - d. Adjacent panels shall be assembled with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
 - e. Stiffeners shall be welded to the back of panels as required to prevent panel deformation due to the weight of face mounted instruments.
 - f. Panels shall be self-supporting as defined below.
- C. Frameworks and Supports:
- 1. The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays. The main framework shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. The framework shall neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.
 - 2. The steel framework shall extend 2 feet 4 inches back from the panel face, or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.
- D. Preparation of Panel Surface:
- 1. The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cut-outs:
 - a. All high spots, burrs, and rough spots shall be ground smooth.
 - b. The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.
 - c. All traces of oil shall be removed with a solvent.
 - d. The first coat of primer shall be applied immediately.
- E. Panel Finishing:

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1. A thin coat primer surface shall be applied over the entire panel surface.
 2. Wet sand, dry, then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.
 3. A primer surface shall be applied on the front of the panel only.
 4. Wet sand to smooth clear finish, then dry.
 5. At least two coats of air-dry, satin finish, lacquer enamel shall be applied over the entire surface. Color shall be as approved by RESIDENT ENGINEER.
 6. Furnish two one-pint containers of air drying, matching paint for field touch-up of the panel face.
- F. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.
- G. Mounting of Instruments:
1. The panel vendor shall provide cut-outs and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in panel (if applicable).
 2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality or as indicated.
 3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.
 4. Spare space shall be kept clear of wiring to give maximum space for future additions.
- H. Electrical Requirements:
1. Conduit, wireways, switches, wire, and electrical fittings shall be provided for all 115 V circuits to instruments and other electrical devices as required for a complete and operable installation.
 2. Conduit, wireways, junction boxes, and fittings shall be provided for all signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between

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temperature sensors and temperature transmitters and between the thermocouple wireway or junction box to instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. All wiring shall be identified with stamped tubular wire and markers.
4. Freestanding panels shall be provided with switched 100-W fluorescent (for energy conservation) back-of-panel lights. One light shall be provided for every 4 feet of panel width and shall be mounted inside and in the top of the back-of-panel area.
5. Freestanding panels shall be provided with a 15-A, 120-V, service outlet circuit within the back-of-panel area. The circuit shall be provided with 3-wire, 120-V, 15-A, duplex receptacles one for every 4 feet of panel width (one minimum per panel), spaced evenly along the back-of-panel area.
6. Wall mounted or pedestal mounted panels shall be so sized as to adequately dissipate heat generated by equipment mounted in or on the panel.
7. Wall mounted or pedestal mounted panels mounted outside or in unshaded areas shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.
8. A hand switch controlled 100-W fluorescent light (for energy conservation and a breaker protected 120-V, 15-A duplex receptacle shall be provided within each wall mounted or pedestal mounted panel.
9. Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated.
10. Signal and Control Circuit Wiring:
 - a. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire UL listed Type MTW, and shall be rated 600 V. Wires for instrument signal circuits and alarm input circuits shall be No. 14 AWG. All other wires, including shielded cables, shall be No. 16 AWG, minimum.
 - b. Wire Insulation Colors: Conductors supplying 120-VAC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120-VAC control circuit

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conductors shall be red. All wires energized by a voltage source external to control panels shall have yellow insulation. Insulation for all DC conductors shall be blue.

- c. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, Brady Type B-500 or equal or shall be permanently marked by heat-shrink plastic.
 - d. Flexible conduit is not acceptable except when specifically approved by the RESIDENT ENGINEER in writing.
 - e. Conduit fittings shall be Crouse-Hinds cast fittings or equal.
 - f. Splicing of wires in conduits is discouraged. If permitted, splicing shall be approved by the RESIDENT ENGINEER and splices shall be soldered or pressure type crimped.
 - g. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with solderless connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be connected to a system ground loop.
11. Electrical Locations:
- a. When CONTRACT DOCUMENTS call for thermocouple actuated instruments, the thermocouple lead wire shall be installed without junction. The panel vendor shall provide dedicated empty conduits or wireways running from the instrument(s) to the top or bottom of the panel as called for in the material specifications or as otherwise required. Sizing of the conduit or wireway shall be in accordance with the capacity of the instrument(s).
 - b. Single case (no remote logic) annunciator units shall be installed at the top of panel and may be considered as a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, a terminal box shall be provided at the bottom of the panel and be wired to the annunciator unit. Terminals shall be identified with plastic marker strips.

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- c. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel as indicated or as otherwise required.
12. Power Supply Wiring:
- a. Unless otherwise indicated, all instruments, alarm systems, and motor controls shall operate on 115-V, 60-Hz circuits.
 - b. At a location near the top of the panel (or bottom), the panel fabricator shall provide terminal box connections for the main power supply entry.
 - c. Power supply switches for alarm units shall be 3-pole type, arranged to open both power circuits and alarm circuits. Each annunciator unit shall be equipped with a separate switch.
 - d. Instruments located on the same panel section and serving the same process unit may be connected to a common branch circuit from the power supply. The number of circuits depends on the circuit load as indicated. A 15-A, 2-pole circuit breaker shall be provided in each branch circuit. The circuit load shall not exceed 10 A. Different panel sections or different process units shall not use common branch circuits. When instruments are not equipped with integral fuses, fuses shall be provided as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by Bussmann Manufacturing Division, Type KAW TRON or equal.
 - e. Each potentiometer type instrument, electronic transducer, controller, or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags indicating instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated.
 - f. Where alarm units are single unit types, one switch may be used to disconnect not more than six alarm units located on the same or adjacent panels.
13. Alarm Wiring: The panel vendor shall provide all alarms including light cabinets, audible signal units, test and acknowledge switches,

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and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be wired by the panel vendor. The wiring from external initiating devices shall be provided by the installation CONTRACTOR. Where plug and cord sets are provided for component interconnection, the panel vendor shall harness and support the cables in neat and orderly fashion. Where separate wire is required, panel vendor shall install No. 16 AWG with THWN or THHN insulation between all components.

14. Signal Wiring:

a. Signal Wire - Non Computer Use:

(3) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation.

(4) Color code for instrument signal wiring shall be as follows:

Positive (+): Black

Negative (-): White

(3) Multiconductor cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 90_C, 600-V fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

b. Signal Wire - Computer Use: Signal wires shall be similar to those for non-computer use, except each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group. All cable shields, including thermocouple extension leads shall be terminated in the central control room at the computer system grounding bus. Continuity of the shield shall be maintained throughout the cable runs.

c. Multi-conductor cables, wireways and conduit shall be sized to allow for 10% spare signal wire.

i. Labor and Workmanship: All panels shall be fabricated, piped and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.3 PLC-SCADA SYSTEM ENCLOSURES

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- A. Each SCADA system PLC and corresponding housing, I/O modules, power supply module(s), communication interface device(s), and peripheral equipment shall be mounted inside a NEMA 12 enclosure. A nameplate shall be mounted on the outside of the door of the enclosure and be engraved with "PLC-X" where "X" is the number as shown on the Drawings. Where indicated, PLCs mounted in free standing enclosures shall be 72 inches tall (maximum) by 26 inches wide (minimum) by 24 inches deep (minimum). Panels shall be mounted on proprietary panel stand/legs 16 inches above ground. Enclosures shall be as manufactured by Hoffman, or equal.
- B. Conduit entry into the PLC or SCADA panel shall be from the bottom only. No conduit entry shall be allowed from the side or top of the panel.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Preparation and Shipping:
 - 1 Crate panels for shipment using a heavy framework and skids. The panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. All instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.
 - 2 All shipments shall be by air ride van, unless otherwise indicated.
 - 3 All control panel testing and inspection shall be performed before shipping.
- B. Control panels shall be installed in accordance with Section 13300 - Instrumentation and Control.

3.2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

- A. Wiring Installation: All wires shall run in plastic wireways except for the following:
 - 1 Field wiring.
 - 2 Wiring between mating blocks in adjacent sections.
 - 3 Wiring from components on a swing-out panel to components on a part of the fixed structure.
 - 4 Wiring to panel-mounted components.

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- B. Wiring Runs: Wiring runs from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.
- C. Wiring to Control Devices: Wiring to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.
- D. Wiring to Rear Terminals: Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.
- E. Shop Drawings shall show conformance to the above wiring installation requirements.
- F. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be plastic-coated cloth, or permanently marked heat-shrink plastic.

3.3 CALIBRATION, TESTING, AND INSTRUCTION

- A. General: Calibration, testing, and instruction shall be performed in accordance with Section 13300 - Instrumentation and Control.

Inspection and Approval:

1. The panel fabricator shall conduct the following tests before shipment:
 - a. All alarm circuits rung out to determine their operability.
 - b. All electrical circuits checked for continuity and where applicable, operability.
 - c. All nameplates checked for correct spelling and size of letters.
 - d. Any other test required to place the panel in an operating condition.
2. The CONTRACTOR shall furnish all necessary testing devices and sufficient manpower to perform the tests required by the CONSTRUCTRESIDENT ENGINEER.

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3. If the above tests have not been performed before shipment, the CONTRACTOR shall be liable for back charges by the RESIDENT ENGINEER for the extra time required for inspections.
4. Each control panel shall be tested in the field for functional operation after the connection of external conductors, and before equipment startup.

**** END OF SECTION ****

SECTION 13374 – CONTROL PANEL INSTRUMENTATION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all control panel instrumentation, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, also apply to the extent required for proper performance of this Work:
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operation and Maintenance Information
 - 3. Section 01750 Spare Parts and Maintenance
 - 4. Section 13300 Instrumentation and Control
 - 5. Section 13370 Control Panels

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings, information, and data sheets shall be submitted in conformance with the requirements of Section 01300 - Submittals, Section 13300 - Instrumentation and Control and Section 13370 - Control Panels.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Current Technology:** Control panel instruments shall be the most recent field-proven models marketed by the manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.
- B. **Hardware Commonality:** All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be the product of one manufacturer.
- C. **Power Supplies:** Power supplies shall conform with the requirements of Section 13300 - Instrumentation and Control.

2.2 PROGRAMMABLE LOGIC CONTROLLERS

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- A. The CONTRACTOR shall provide, program, test, calibrate, fully configure, and place into operation Programmable Logic Controllers (PLCs) as indicated herein.
1. The CONTRACTOR shall provide all necessary interconnecting cables, accessories, and appurtenances as indicated herein or as required for proper operation of the system. All major components of the system shall be the product of the same manufacturer. All equipment shall be capable of tolerating and capable of riding through a power interruption of 25 milliseconds or less without interruption of normal operation.
 2. Construction: The PLC central processing unit (CPU) shall be of solid-state design. The controller shall be capable of operating in a hostile industrial environment with heat, electrical transients, RFI, vibration, temperatures up to 140 degrees F, and 95% humidity without fans, air conditioning, or electrical filtering.
 3. Design: The PLC shall be furnished with I/O (input/output) points suitable for the interface with all field devices. The I/Os shall be 4-20 mA signals for analog inputs and outputs and shall be 24 VDC signals for discrete inputs and discrete outputs unless otherwise directed by the RESIDENT ENGINEER. The PLC shall provide internal fault analysis with a fail-safe mode and a local indicator on the PLC in the event of a fault in the PLC. When the PLC digital output is driving a load that exceeds its contact rating, provide interposing relays "ice-cube" type, form C, DPDT, 10A at 120 VAC contact rating, with silver cadmium oxide contacts or gold-plated contacts for low level signals. The relays shall be IDEC or Potter Brumfield.
 - a. Central Processor: The central processor shall contain all the relays, timers, counters, shift registers, and sequencers necessary to perform the control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs to meet the requirements plus an additional 25% excess capacity. The power supply shall contain capacitors to provide orderly shutdown in the event incoming power does not meet specifications. If this occurs, the processor shall cease operation, forcing all outputs off. The processor shall have a key type memory protect switch to prevent unauthorized program changes.
 - b. Memory: The programmable controller memory shall be Complementary Metal Oxide Semi-conductor (CMOS) based memory with battery backup and Electrically-Erasable Programmable Read-Only Memory (EEPROM) based memory. The CMOS memory shall be a minimum

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of 1200 words with sufficient battery backup to retain the program during power interruptions of up to 1 year. An indicator shall show the status of the batteries. A reference shall be available through the discrete outputs to alarm the operator that the batteries should be changed.

- c. The PLC shall be supplied with sufficient memory to implement the control function plus a reserve capacity of 25% of the total provided. This reserve capacity shall be totally free from any system use.
 - d. Controller: The controller shall be programmed in "ladder diagram" language utilizing Concept XL SR7 software, no exceptions. The PLC system shall be programmed by the Instrumentation Subcontractor to perform the indicated control and monitoring functions. The City will provide the application software to the CONTRACTOR and the CONTRACTOR shall provide two documented copies of the operating program which shall allow direct, step-by-step, reloading of the system program. Each rung shall be annotated to describe the logic that takes place at the rung. Copies of this program shall be furnished in the format used in the contract diagrams for conventional relay control systems. These diagrams shall reflect equipment name designations used in the PLC as well as the contract diagram equipment name designations.
 - e. The PLC shall be Modicon Quantum programmable controller. No substitutions will be accepted. Specific CPU model number shall be Schneider Electric, 140CPU 53414B with 2.5Mb user memory, 80486 processor, 2 Modbus ports and 1 Modbus Plus port. Power supply shall be 140CPS21400.
 - f. The PLC shall be supplied with an Ethernet module within the rack line up to communicate with the ethernet switch. Model number shall be 140NOE77111.
4. Input/Output: All I/O housings shall be of rugged construction with modules in place. Sufficient inputs and sufficient outputs shall be provided with the PLC to implement the control functions plus an I/O reserve capacity of 20% of the total provided. In addition, the PLC rack shall have an additional 30% space capacity for future use.
- a. Discrete Inputs: Defined as contact closure inputs from devices external to the programmable logic controller module. Inputs shall be shielded from short time constant

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noise and 60 Hz pickup. Individual inputs shall be optically isolated for low energy common mode transients to 1500 V peak from user's wiring or other I/O. The PLC shall have LED lights to indicate a discrete input. Model number 140DDI35300.

- b. Discrete Outputs: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable logic controller. The outputs shall be fused (typically 5 A at 115 VAC) with blown fuse indicator lights. The outputs shall be optically isolated from inductively generated, normal mode, and low energy, common mode transients to 1500 V peak. All outputs shall have LED lights to indicate output has been cycled ON by the controller. Model number 140DDO35300.
- c. Analog Inputs: 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. Model number 140ACI0400.
- d. Analog Outputs: Defined as analog output signals from the PLC within the range of 4 to 20mA DC. A digital to analog conversion is performed and analog output sent out from the PLC. Model number 140ACO13000.

5. Operator Interface Terminal (OIT)

- a. Provide, program, test, fully configure, document, and place into operation Operator Interface Terminal (OIT) units for operator controls and monitoring functions as indicated herein. OIT controls, monitoring functions and displays shall be provided to meet the functional requirements shown on the process and instrumentation diagrams (P&IDs) and described in the Control Strategy section.
 - (1) The OIT shall be a panel-mounted electronic assembly that allows bi-directional communication with the PLC.
 - (2) The OIT shall have a minimum of 15 inches diagonal, color display with 1024 by 768 pixel resolution, and touch screen capability. Each unit shall employ flash memory for storing the application specific symbols and data. Each unit shall be capable of handling up to 160 touch

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areas per screen display and a minimum of 25 screens. Each touch area shall provide audible feedback to the operator.

- b. Graphics: An operator will monitor and control the system using a number of preconfigured graphic displays which represent the particular equipment and processes being controlled. Graphic displays shall be provided illustrating each process using symbols to represent equipment with process flow direction lines connecting the symbols. Symbols shall be used for pumps, motors, valves, and primary elements. The description shall be included adjacent to each discrete graphic symbol. The point description, current value, and engineering units shall be displayed adjacent to each analog graphic symbol. Device status colors for graphic symbols shall be red for energized, green for normal or not energized, purple for bad quality, and flashing yellow for alarm. Unacknowledged alarm messages shall flash. The operator shall be alerted to the most recent active alarm message which shall appear on every screen. Alarms that have been acknowledged, but are still active shall appear without flashing. Alarm acknowledge from the OIT shall also silence the external alarm horn, where provided. Acknowledged alarms shall automatically reset (removed from the alarm display) when the alarm condition is no longer active. All process lines, structures, and equipment shall be identified with the proper nomenclature. The P&IDs shall be used to help generate graphics displays.
- c. Displays: A complete set of each of the following OIT displays shall be provided. A minimum of 10 configured displays shall be provided:
 - (1) System overview graphic and main menu display.
 - (2) Detailed graphic displays showing all equipment monitored and controlled from the OIT.
 - (3) Faceplate displays for the following:
 - (a) Equipment START/STOP control, control mode selection, status indication, and FAULT alarming.
 - (b) Analog controller process variable indication, set point and output

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- manipulation, and controller mode indication.
 - (c) Indication of continuous variables including measured process valves, flow totals, and elapsed time indications.
 - d. Process Trending Displays:
 - (1) Real-time Trends: Continuous plotting of variables as a function of time for up to 24 hours.
 - e. Alarm Summary Displays
 - f. Hardware Diagnostics Displays
 - g. Display Organization: Displays and items included on the displays shall be functionally organized and clearly labeled to allow convenient and efficient monitoring and control actions by an operator.
 - h. Display Access: The displays shall be configured to allow convenient access from one display to another. Detail displays shall be accessible from overview menu displays as well as from associated detail displays using FORWARD/BACKWARD key functions. Any display shall be accessible from any other display in a minimum of keystrokes but in all cases no more than three keystrokes or touch actions. All displays shall include an alarm indicating whenever any alarm condition occurs. The alarm summary display shall be accessible from any display by no more than one keystroke or touch action.
 - i. Communication: The unit shall communicate with the PLC via ethernet link. Communication driver software shall be provided with the configuration software.
 - j. Cables: Cables for connection of the OIT to the PLC, and to a personal computer shall be provided.
 - k. Manufacturer: The operator interface device shall be Modicon Magelis XBTGT7340, no exceptions.
6. DC to DC Converters: Converter shall be suitable for DIN rail mounting inside the PLC panel, and convert a 24V DC input signal to 12VDC output circuit. The converter shall have a low ripple and noise characteristic and provide overload and short circuit protection to the output circuit. The converter shall be UL listed and be suitable

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for operation in a temperature range of 14 degrees F to 158 degrees F. Converter shall be Rhino, model PSP12-DC24-2 or equal.

7. Programming Unit: Programming shall be accomplished with a laptop PC programmer provided by the CONTRACTOR. The laptop programmer is not required to be furnished to the RESIDENT ENGINEER. The programmer shall be capable of being directly plugged into the PLC system without the requirements of additional hardware. All programming, all monitoring, all searching, and all editing shall be accomplished with the programmer. These functions shall be capable of being done "off line" while the processor is not scanning. The programmer shall monitor the status of inputs, outputs, timers, counters, and coils. It shall have the capability to disable/force inputs, outputs, and all coils to simulate system operation. The programmer shall be of rugged construction and be portable, allowing it to be used in an industrial environment without special protection.
8. Seven Day Acceptance Test: After start-up has been completed, the System shall undergo a 7-day acceptance test. The System shall run continuously for 7 consecutive days. During this period, all System functions shall be exercised. Any System interruption and accompanying component, subsystem, or program failure shall be logged for the cause, time of occurrence and duration of each failure. A failure shall cause termination of the 7-day acceptance test. When the cause of a failure has been corrected, a new 7-day acceptance test shall be started.
9. Each time the CONTRACTOR's technician is required to respond to a System malfunction, a report shall be prepared which includes details on the nature of the complaint or malfunction and the resulting repair action required and taken.
10. Operations and Maintenance Information: The CONTRACTOR shall furnish 5 complete sets of operation and maintenance information in compliance with Section 01730 - Operations and Maintenance Information. The submittals shall include date, information drawings, etc., for the system, subsystem, and all components, and shall include names, addresses and telephone numbers of equipment suppliers, representatives, and repair facilities.
 - a. A complete description shall be provided of the recommended operating procedures, maintenance procedures, and spare/replacement parts list for equipment items with catalog data, diagrams, and drawings or cuts describing the equipment.

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- b. Each set shall include full size assembly and wiring diagrams documenting "as-built" conditions.

2.3 COMMUNICATIONS

A. General:

1. The PLC shall communicate with the other RTUs and other devices on the SCADA system via a radio antenna system. All ports, modems, and other communications equipment shall be provided in accordance with the functional requirements of the system. The radio model shall be GE, , SD09MD-CES-NNSNN, no exceptions.

B. Environmental Conditions:

1. The PLC shall be able to operate in environments with the following specifications:
 - a. Temperature range: -3 to +60 deg. C.
 - b. Humidity: 95% at 40 deg. C.
 - c. Shock and Vibration: MIL 810C Spec.

C. Radio Transmitter:

1. The radio shall meet the following transmitter requirements:
 - a. Output Power (at antenna port): 5 Watts (+37DBm) max.
 - b. Transmitter Attack Time: Less than 1 msec for 90% power within 1 KHz of operation frequency
 - c. Output Frequency: 928 to 960 MHz
 - d. Stability: +/-0.00015% from -30 to +60 degrees C (for both 12.5 KHz and 25 KHz channels)
 - e. Spurious/Harmonic Emissions: 55 DB
 - f. Output Impedance: 50 ohms
 - g. Modulation Deviation: +/- 5 KHz FM (25 KHz channels), +/- 3 KHz (12.5 KHz channels)
 - h. Duty Cycle: Continuous

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- i. Audio Input Level: Adjustable, -20 to +1- DBm for 5 KHz dev.
 - j. Frequency Response: +1 to -3 DB, 20 to 3 KHz
 - k. Time Out Timer: Adjustable (2 to 30 seconds)
 - l. AFC Circuit: Built in
- D. Radio Receiver:
- 1. The radio shall meet the following receiver requirements:
 - a. Sensitivity at the antenna port: 0.3 microvolts (-117 DBm), for 12 DB Sinad
 - b. Frequency Stability: +/-0.00015% from -30 to +60 degrees C (for both 12.5 and 25 KHz channels)
 - c. Frequency Range: 952 to 953 MHz
 - d. Selectivity: -10 DB minimum at adjacent channel
 - e. Desensitization: -70 DB minimum (EIA)
 - f. Spurious/Image Rejection: -85 DB minimum
 - g. Audio Output Levels: Adjustable, -20 to +6 DBm
 - h. Frequency Response: Flat output: +1, -3 DB, 20 to 6000 Hz
 - i. AFC Circuit: Built in
 - j. Intermodulation (EIA): -75 DB, minimum
- E. Miscellaneous:
- 1. The radio shall meet the following general requirements:
 - a. Input Power: 12 to 30 VDC Nominal
 - b. Transient Protection: 2500 Volt Isolation on VF I/O; power supply, keying, and alarm circuits
 - c. Data Rate: 4800 Baud

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- d. Built in Modem: 4800 Baud Async Digital Interface. RS232 direct Interface: RTS/CTS time not to exceed 10 msecs
- e. Antenna Connection: Type N, female
- f. Unit Housing: Inside SCADA panel
- g. Other features: Diagnostic option

2.4 ANTENNA

A. The Broadband Yagi Antenna shall be manufactured by SCALA, model TY-900, and shall meet the following specifications:

- 1. Frequency Range: 925 to 960 MHz
- 2. Gain: 10 DB, minimum
- 3. Maximum Input Power: 150 Watts
- 4. Lightning Protection: Direct Grounding to mast
- 5. Front to Back Ratio: 20 DB, minimum
- 6. Connector: Type N, Female
- 7. Mounting Hardware: Weatherproof clamp suitable for direct mount to 2 inch SCH, 40 steel pipe

8. VSWR: 1.5:1 max (1.35:1 typ.)B. Antenna systems shall be provided complete and functional for the intended use. System shall include antenna, mounting mast, hardware, grounding accessories and coaxial cables with connectors. Antenna height shall be based on the radio survey provided by the City and shall not exceed FCC limitations. Radio and antenna configuration instructions shall be provided by the City.

C. Antenna mounting components and hardware shall be hot-dip galvanized steel, stainless steel or aluminum. Aluminum antennas or hardware shall be anodized. Lightning arrestors shall be provided on antenna coaxial feed lines.

D. Antenna connections shall be sealed and weatherproof.

2.5 LIGHTNING ARRESTOR

A. General:

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1. The lightning arrestor shall be Polyphaser, model IS-50NX-C2, and shall meet the following requirements:
 - a. Max. Surge: 50KAmps IEEE 8/20 Waveform (based on IEEE Std. 281974 and ANSI C62.1)
 - b. Turn on VDC: 60 V. Typical
 - c. Turn On Time: 7ns after DC Threshold (based on 1 KV/nS waveform)
 - d. Impedance: 50 Ohms
 - e. Frequency Range: 900 to 1000 MHz
 - f. VSWR: ≤ 1.1 to 1 over operating Bandwidth
 - g. Insertion loss: ≤ 0.1 DB over operating Bandwidth
 - h. Temperature Range: 60 to -30 degrees C.

B. Connections:

1. The arrestor shall have male Type N connectors for the input and the output. The arrestor shall have a flange mounting arrangement to aid connection to ground. The arrestor shall be in a conductive, metallic enclosure.

C. Antenna Cable:

2. The antenna cable shall be 1/2" foam dielectric, manufactured by Andrews Helix, part number LDF5-50A. Two Andrew type L44PLU "N" male connectors.

2.6 SPARE PARTS

A. The following spare parts shall be provided:

1. One of each type I/O cards used.
2. One spare power supply of each type used.
3. One spare radio transceiver.
4. Two program back-up batteries.
5. Five of each type fuse used.

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6. One box of program storage medium (i.e., DVD), or thumb drive or external hardisk with sufficient storage.

2.7 BATTERY BACK UP SYSTEM

- A. The power back up system shall be capable of powering the radio, PLC and other panel components in the event of utility power failure for a period of 8 hours. The battery backup system shall be isolated from the utility power, upon failure of which, the power shall be transferred to battery system by use of relay contacts and diodes. Battery tapping of a 24V power system to obtain 12V is not acceptable. Use DC to DC converter specified above where 12V DC is required. Battery charger shall be provided with a single 120V, 1 phase AC power feed and shall provide a single 24V DC power limited output for use inside the PLC panel.
- B. Each battery backup system shall include signals for low battery voltage condition and utility power failure/battery system ON signal. Batteries shall be designed for standby power use and sized to operate the load for 8 hours. Batteries shall be gel type lead dioxide with sealed construction, be capable of at least 200 charge-discharge cycles and have a service life of at least 3 years.
- C. Battery chargers shall be designed to charge the type of battery furnished. The charger shall be automatic dual rate and produce the voltage and current recommended by the battery manufacturer to ensure maximum battery life. Wiring shall be per NEC requirements and battery charger shall be UL listed.
- D. CONTRACTOR shall furnish calculations for battery sizing for approval. All 24VDC and 12V DC loads inside PLC panel including PLC components, relays, radio system and other control panel instrumentation, shall be powered from the battery charger system for a backup service of 8 hours in the event of utility power failure. If required due to limitation of size, batteries shall be installed in a separate enclosure from the battery charger. Enclosures shall be NEMA 1 gasketed.
- E. Battery charger system shall be of Altronix; model eflow104NX with appropriately sized batteries, no exceptions.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Execution requirements of Section 13300 - Instrumentation and Control and Section 13370 - Control Panels shall apply to this Section.

3.2 FIELD TESTING OF RADIO EQUIPMENT

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- A. The following measurements shall be made, recorded and compared to normal reading on each RF assembly prior to system testing to ensure that all equipment meets published specifications:
1. Operating voltages
 2. Transmitter frequency
 3. Transmitter output power (at output of duplexer)
 4. Transmitter deviation
 5. Receiver local oscillator frequency
 6. Receiver sensitivity (10 to -6 BER)
- B. Testing: All systems furnished under this Contract shall be exercised through operational tests in the presence of the RESIDENT ENGINEER in order to demonstrate compliance with requirements. The testing of the radio communication system shall be performed in accordance with and as an integral part of the testing of the instrumentation and control specified in Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

SECTION 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, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.
- B. The piping shown in the drawings is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The drawings are not pipe construction or fabrication drawings. It is the CONTRACTOR's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, and other appurtenances for a complete and functional system.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operations and Maintenance Information
 - 3. Section 02666 Water Pipeline Testing and Disinfection
 - 4. Section 05500 Miscellaneous Metals
 - 5. Section 09800 Protective Coating
 - 6. Section 11000 Equipment General Provisions
 - 7. Section 15020 Pipe Supports
 - 8. Section 16640 Cathodic Protection System

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Work of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:
 - 1. California Mechanical Code

SECTION 15000 – PIPING COMPONENTS

2. California Plumbing Code
 3. California Fire Code
- B. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- C. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as indicated in each Section:
1. American Society for Testing and Materials (ASTM)
 2. American National Standards Institute (ANSI)
 3. American Society of Mechanical Engineers (ASME)
 4. American Water Works Association (AWWA)
 5. American Welding Society (AWS)
 6. American Iron and Steel Institute (AISI)
 7. National Fire Protection Association (NFPA)
- D. The following standards have been referenced in this Section:
- | | | |
|----|-------------------|---|
| 1. | ANSI/ASME B1.20.1 | Pipe Threads, General Purpose (inch) |
| 2. | ANSI B16.5 | Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24 |
| 3. | ANSI/AWWA C207 | Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in. |
| 4. | ANSI/AWWA C606 | Grooved and Shouldered Joints |
| 5. | ANSI/AWS D1.1 | Structural Welding Code B Steel |
| 6. | ASTM A 36 | Specification for Carbon Structural Steel |
| 7. | ASTM A 283 | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |

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- | | | |
|-----|-----------------|--|
| 8. | ASTM A 285 | Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength |
| 9. | ASTM A 307 | Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength |
| 10. | ASTM A 325 | Specification for High-Strength Bolts for Structural Steel Joints |
| 11. | ASTM A 563 | Specification for Carbon and Alloy Steel Nuts |
| 12. | ASTM D 2000 | Classification System for Rubber Products in Automotive Applications |
| 13. | ASTM/AWWA C219 | Bolted, Sleeve-Type Couplings for Plain-End Pipe |
| 14. | AWWA Manual M11 | Steel Pipe - A Guide for Design and Installation |

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems for review by the RESIDENT ENGINEER in accordance with the requirements in Section 01300 - Submittals, and as indicated in the individual piping sections. The shop drawings shall include dimensions and details on pipe joints, fittings, fitting specials, harnessed joints, valves, and appurtenances, and shall include design calculations and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system.
- B. The CONTRACTOR shall submit information in compliance with Section 01730 - Operations and Maintenance Information, containing the following:
1. Manufacturer's product data.
 2. Manufacturer's installation instructions.
 3. Manufacturer's certification of compliance.
 4. Statement from the pipe fabricator certifying that all pipe will be fabricated subject to a Quality Control Program.

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5. Outline of Quality Control Program.

1.5 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the RESIDENT ENGINEER 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 RESIDENT ENGINEER 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 RESIDENT ENGINEER.
- C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- D. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing Work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders at no increased cost to the OWNER.

1.6 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable in order to obtain perfect pipe joints, supports, or special connections, the CONTRACTOR shall furnish such assistance at no additional cost to the OWNER.

1.7 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and shall be stored off the ground to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

SECTION 15000 – PIPING COMPONENTS

1.8 CLEANUP

- A. After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site by the CONTRACTOR. The entire piping system shall be handed over to the OWNER in a clean and functional condition.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Divisions 2 and 15 and this Section.
- B. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of Section 15020 - Pipe Supports, and as indicated.
- C. Lining: The thickness, application, and curing of pipe lining shall be in accordance with the requirements of the applicable Sections of Division 2, unless otherwise indicated.
- D. Coating: The thickness, application, and curing of pipe coating shall be in accordance with the requirements of the applicable Sections of Division 2, unless otherwise indicated. Pipes installed above ground or in structures shall be field-painted in accordance with Section 09800 - Protective Coating.
- E. Pressure Rating: All piping systems shall be designed for the maximum expected pressure of 150 psi , or as indicated on the piping schedule.
- F. Grooved Piping Systems: Grooved couplings on buried piping shall be bonded. All grooved fittings, couplings, and valves shall be from the same manufacturer.

2.2 PIPE FLANGES

- A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-pound class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-pound class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207. All blind flanges for pipe diameters 12-inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.

SECTION 15000 – PIPING COMPONENTS

- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: All bolts and nuts shall conform to Section 05500 - Miscellaneous Metals. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.
- E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.
- F. Insulating Flange Sets: Insulating flange sets shall be provided where shown on the Drawings. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inches or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be two-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.
- G. Insulating Flange Manufacturers, or Equal:
 - 1. Reflange by Taylor Forge, Houston, Texas
 - 2. PSI Products, Inc., Gardena, California.
- H. Flange Gaskets: Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of asbestos-free aramid fiber base, with nitrile binder and nonstick coating, suitable for temperatures to 700 degrees F, a pH of 1 to 11, and pressures to 1,000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets will not be permitted.
- I. Flange Gasket Manufacturers, or Equal:
 - 1. John Crane, Style 2160.
 - 2. Garlock, Style 3000.

2.3 THREADED INSULATING CONNECTIONS

- A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.
- B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

SECTION 15000 – PIPING COMPONENTS

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. General: Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. Bolts and nuts shall conform to the requirements of Section 05500 - Miscellaneous Metals. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The CONTRACTOR shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.
- B. Manufacturers of Couplings for Steel Pipe, or Equal:
1. Victaulic Style 41 or 44 (banded, flexible).
 2. Victaulic Style 77 (grooved, flexible).
 3. Victaulic Style 07 or HP-70 (grooved, rigid).
- C. Manufacturers of Ductile Iron Pipe Couplings, or Equal:
1. Victaulic Style 31 (flexible or rigid grooving), furnished with flush seal gaskets.
- D. Manufacturers of Couplings for PVC Pipe, or Equal:
1. Victaulic Style 775, furnished with radius cut or standard roll grooved pipe ends.

2.5 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where indicated on the Drawings, in accordance with ANSI/AWWA C219 unless otherwise indicated on the Drawings, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7-inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts for

SECTION 15000 – PIPING COMPONENTS

buried couplings shall be Type 316 stainless steel. Bolts and nuts for exposed couplings shall conform to the requirements of Section 05500 - Miscellaneous Metals and shall be coated in accordance with Section 09800 - Protective Coating. Buried sleeve-type couplings shall be fusion bonded epoxy lined and coated at the factory in accordance with AWWA C213, and shall also receive a petrolatum/wax tape coating in accordance with Section 09800 - Protective Coating.

- B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. Gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid conveyed. The rubber in the gasket shall meet the following specifications:
1. Color - Jet Black.
 2. Surface - Nonblooming.
 3. Durometer Hardness - 75 ± 5 .
 4. Tensile Strength - 1,000 psi minimum.
 5. Elongation - 175 percent minimum.
- D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- E. Restrained Joints: Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall conform to the requirements of the appropriate reference standard, to the requirements specified herein, or to the Drawings.

SECTION 15000 – PIPING COMPONENTS

1. Joint Harnesses for Sleeve-Type Couplings on Steel Water Pipelines: Bolts and stud materials shall conform to ASTM A307, Grade B. Nuts shall conform to ASTM A563, Grade A, heavy hex. Lug material shall conform to one of the following: ASTM A36; ASTM A283 Grade B, Grade C, or D; or ASTM A285, Grade C. Lug dimensions shall be as shown in AWWA Manual M11. Lugs shall be Type P for pipe from 6-through 10-inch diameter, and Type RR for pipe 12-inch diameter and larger.
2. End Thrust: Joint harnesses shall be designed to accommodate the design working pressure of 130 psi plus a surge allowance of 65 psi.
3. Coating of Joint Harnesses: Coatings for joint harnesses shall conform to Section 09800 - Protective Coating. Buried joint harnesses shall be coated with a petrolatum/wax tape coating in accordance with Section 09800 - Protective Coating.

F. Manufacturers, or Equal:

1. Dresser, Style 38.
2. Ford Meter Box Co., Inc., Style FC1 or FC3.
3. Smith-Blair, Style 411.

2.6 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, compressors, and other vibrating equipment, and where shown on the Drawings. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application, unless otherwise shown. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown on the Drawings. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown on the Drawings. The final material selection shall be approved by the manufacturer. The CONTRACTOR shall submit to the RESIDENT ENGINEER manufacturer's shop drawings and calculations.

2.7 EXPANSION JOINTS

- A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other

SECTION 15000 – PIPING COMPONENTS

materials, best suited for each individual service. The CONTRACTOR shall submit to the RESIDENT ENGINEER detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

2.8 PIPE THREADS

- A. All pipe threads shall be in accordance with ANSI/ASME B1.20.1

PART 3 -- EXECUTION

3.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of Divisions 2 and 15. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.
- B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.

**** END OF SECTION ****

SECTION 15020 – PIPE SUPPORTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pipe supports, seismic restraints, hangers, guides, and anchors, complete, in accordance with the requirements of the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

- 1. Section 01300 Submittals
- 2. Section 05500 Miscellaneous Metals
- 3. Section 09800 Protective Coating
- 4. Section 15000 Piping Components

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Applicable commercial standards are defined in Section 15000 - Piping Components.

- B. The following standards have been referenced in this Section:

- 1. ANSI/ASME B31.1 Power Piping
- 2. ASTM A123 Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- 3. California Building Code (CBC)
- 4. Manufacturer's Standardization Society (MSS):
 - a. SP58, Pipe Hangers and Supports – Materials, Design and Manufacturing
 - b. SP127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Applications.

1.4 CONTRACTOR SUBMITTALS

SECTION 15020 – PIPE SUPPORTS

- A. General: Submittals shall be in accordance with Section 01300 - Submittals and Section 15000 - Piping Components.
- B. Shop Drawings: Shop drawings shall include the following information:
 - 1. Pipe supports, restraints, hangers, anchors, and guides
 - 2. Calculations for special supports and anchors.
- C. Calculations for each type of pipe support, attachment and anchor.
- D. Piping support system shall be designed and shop drawing prepared and sealed by a licensed civil or structural Engineer in the State of California.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.
- B. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided at no additional cost to the OWNER. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the RESIDENT ENGINEER.
- C. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.
- D. Hangers Subject to Horizontal Movements: At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees

SECTION 15020 – PIPE SUPPORTS

from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

- E. Spring-Type Hangers: Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least four times the maximum travel due to thermal expansion.
- F. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.
- G. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- H. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- I. Materials of Construction:
 - 1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.
 - 2. Submerged Supports: All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.
 - 3. Corrosive Areas: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

SECTION 15020 – PIPE SUPPORTS

- J. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.
- K. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

- A. Supports for piping shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

- 1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
2	6
3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and 22	30

- 2. Support Spacing for Welded Fabricated Steel Pipe:

Maximum Spans (feet) for Pipe Supported in Minimum 120 Degree Contact Saddles

SECTION 15020 – PIPE SUPPORTS

Nominal Pipe Diameter (inches)	Wall Thickness B inches									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	42	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	--	40	43	47	50	52	56			
45	--	40	44	47	50	53	57			
48	--	40	44	47	50	53	58	61		
51	--	41	44	48	51	53	58	62		
54	--	41	44	48	51	54	58	62		
57	--	41	44	48	51	54	59	63		
60	--	41	45	48	52	54	59	63	67	70
63	--	41	45	49	52	55	60	64	67	71
66	--	41	45	49	52	55	60	64	68	71
72	--	41	45	49	52	55	61	65	69	72
78	--	41	45	49	53	56	61	66	69	73
84	--	41	46	50	53	56	62	66	70	74
90	--	41	46	50	53	56	62	67	71	74
96	--	42	46	50	54	57	62	67	71	75

For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = [(7500tD)/(32t + D)]^{0.5}$$

SECTION 15020 – PIPE SUPPORTS

where: t = Thickness (inches)
 D = Diameter (Inches)
 L = Maximum span (feet)

3. Support Spacing for Ductile-Iron Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
All diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

4. Support Spacing for Copper Tubing:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
1/2 to 1-1/2	6
2 to 4	10
6 and greater	12

5. Support Spacing for Schedule 80 PVC Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (at 100 degrees F) (feet)</u>
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

6. Support Spacing for Schedule 80 Polypropylene Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (at 100 degrees F) (feet)</u>
1/2	3
3/4	3.5
1	3.75
1-1/4	4

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1-1/2	4.25
2	4.5
3	5.5
4	6
6	7.25
8	8
10	8.75
12	9.5

7. Support Spacing for Fiberglass Reinforced Plastic (FRP) Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
2	8.8
3	10
4	11
6	12.7
8	13.4
10	14
12	15.4
14	16.2
16	17.3
18 and greater	18

2.3 MANUFACTURED SUPPORTS

- A. Stock Parts: Designs shall exemplify good engineering practice and use stock or production parts. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. Manufacturers, or equal:
 - 1. Bergen-Paterson Pipesupport Corp., Woburn, MA
 - 2. Grinnell Corp., Exeter, PA

2.4 COATING

- A. Galvanizing: Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. Other Coatings: Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09800 - Protective Coating.

SECTION 15020 – PIPE SUPPORTS

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: All pipe supports, seismic restraints, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the form work.
- B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, and without interference with other work.

3.2 FABRICATION

- A. Quality Control: Pipe hangers, supports, and seismic restraints shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

**** END OF SECTION ****

SECTION 15030 – PIPE IDENTIFICATION SYSTEMS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide identification for all exposed piping and valves, in accordance with the requirements of the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 02645 PVC Pressure Pipe (4-inch and Smaller)
 - 3. Section 02646 PVC Pressure Pipe (Larger than 4-inch)
 - 4. Section 09800 Protective Coating
 - 5. Section 15000 Piping Components
 - 6. Section 15100 Valves, General
 - 7. Divisions 2, 11, 13, 15, as applicable

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Applicable commercial standards conform to the requirements of Section 15000 - Piping Components.
- B. The following standards are referenced in this Section:
 - 1. ANSI A13.1 Scheme for the Identification of Piping Systems

1.4 CONTRACTOR SUBMITTALS

- A. All submittals shall be in strict accordance with the requirements of Sections 01300 - Submittals and Section 15000 - Piping Components.
- B. The CONTRACTOR shall submit samples of all types of identification devices to be used in the Work.
- C. Before fabrication starts, the CONTRACTOR shall submit a list of suggested wording for all valve tags.

SECTION 15030 – PIPE IDENTIFICATION SYSTEMS

PART 2 -- PRODUCTS

2.1 IDENTIFICATION OF PIPING

- A. Identification of all exposed pipe shall be accomplished by color-coding with bands and by lettering as specified in Part 3 herein and in Section 09800 - Protective Coating. Color bands shall either be painted directly upon the pipe or shall be pressure-sensitive adhesive-backed vinyl cloth or plastic tape.
- B. Each pipe identification shall consist of two color-coded bands, a printed label identifying the name of the pipe, and a flow arrow to indicate direction of flow in the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Arrows shall be die-cut of the same type of material as the labels.
- C. Letter sizes and colors for lettering, arrows, and background shall conform to ANSI A13.1.
- D. Preprinted identification devices shall be as manufactured by W.H. Brady Co.; Seton Nameplate Corp.; or equal.

2.2 EXISTING IDENTIFICATION SYSTEMS

- A. In installations where existing piping identification systems have been established, the CONTRACTOR shall continue to use the existing system. Where existing identification systems are incomplete, the CONTRACTOR shall utilize the existing system as far as practical and supplement with the specified system. The objective is to fully identify all new piping, valves, and appurtenances to the level specified herein.

2.3 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

- A. Identifying devices for valves and the sections of pipe that are too short to be identified with color bands, lettered labels, and arrows shall be identified with metal or plastic tags as indicated.
- B. Metal tags shall be of stainless steel with embossed lettering. Plastic tags shall be of solid black plastic laminate with white embossed letters. All tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All labels and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. All such tags or labels shall be readily visible from all normal working locations.

SECTION 15030 – PIPE IDENTIFICATION SYSTEMS

3.2 VALVE TAGS

- A. Valve tags shall be permanently attached to the valve or structure by means of two stainless steel bolts or screws.
- B. The wording on the valve tags shall describe the exact function of each valve, e.g., "REW THROTTLING", "RW-PUMP SHUT-OFF," etc.

3.3 PIPE IDENTIFICATION

- A. Each pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point approximately within 2 feet of all turns, ells, valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with color bands, lettered labels, and directional arrows shall be tagged and identified similar to valves.
- B. Pipe identification shall consist of 4 elements, i.e., 2 color bands, a lettered label, and a directional label. The bands shall be arranged so that the lettered label and the directional arrow is placed between the 2 bands.

3.4 IDENTIFICATION SCHEDULE

- A. Application of identifying devices shall conform to the following color codes.

Fluid Identification <u>Abbreviation</u>	<u>Function and Identification</u>	<u>Color</u>
CD	Chemical drain and vent	orange
CLS	Chlorine solution	orange
CV	Chlorine vent & detection line	yellow
EE	Engine exhaust	aluminum
EWR	Engine cooling water return	blue
EWS	Engine cooling water supply	blue
FOR	Fuel oil return	orange
FOS	Fuel oil supply	orange
FSP	Fire protection sprinkler system	red
IA	Instrument air	aluminum
LO	Lube oil	orange
LSP	Landscape sprinkler system	blue
NG	Natural gas	yellow
OF	Overflow	blue
PW	Potable water	green
REW	Reclaimed water	blue
RW	Raw water	blue
RWL	Rain water leader	blue
SA	Sample lines	blue

SECTION 15030 – PIPE IDENTIFICATION SYSTEMS

SC	Spare chemical	orange
SD	Sanitary drains and vents	blue
SDR	Storm drain	blue

Fluid Identification <u>Abbreviation</u>	<u>Function and Identification</u>	<u>Color</u>
SPD	Sump pump discharge	blue
SS	Sanitary sewer	blue
SUC	Structure underdrain collector	blue
UW	Utility water (nonpotable water)	blue
V	Vacuum	aluminum
WLO	Waste lube oil	orange

**** END OF SECTION ****

SECTION 15100 – VALVES, GENERAL

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all valves, operators, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS. This Section applies to all valves and valve operators except where otherwise indicated. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls as indicated in other Sections.
- B. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the RESIDENT ENGINEER 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, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01730 Operation and Maintenance Information
 - 3. Section 05500 Miscellaneous Metals
 - 4. Section 09800 Protective Coating
 - 5. Section 11000 Equipment General Provisions
 - 6. Section 15000 Piping Components
 - 7. Section 15030 Piping Identification Systems
 - 8. Section 15101 Valve and Gate Operators
 - 9. Section 15103 Globe Valves
 - 10. Section 15104 Butterfly Valves
 - 11. Section 15105 Check Valves

SECTION 15100 – VALVES, GENERAL

12. Section 15106 Ball Valves
13. Section 15109 Gate Valves
14. Section 15110 Plug Valves
15. Section 15113 Air Release and Vacuum Valves
16. Section 15114 Pressure Regulating Valves
17. Section 15115 Miscellaneous Valves
18. Section 15117 Pump Control Valves
19. Section 16040 Electric Motors

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 1. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings
 2. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings
 3. ANSI/ASME B16.47 Large Diameter Steel Flanges: NPS 26 through NPS 60
 4. ANSI/ASME B1.20.1 Pipe Threads (Inch), General Purpose
 5. ANSI/ASME B31.1 Power Piping
 6. ASTM A36 Standard Specification for Carbon Structural Steel
 7. ASTM A48 Standard Specification for Gray Iron Castings
 8. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

SECTION 15100 – VALVES, GENERAL

9. ASTM A216 Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service
10. ASTM A351 Standard Specification for Steel Castings, Austenitic, Austenitic-Ferric (Duplex), and Pressure-Containing Parts
11. ASTM A395 Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
12. ASTM A515 Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher Temperature Service
13. ASTM A536 Standard Specification for Ductile Iron Castings
14. ASTM A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Purposes
15. ASTM B61 Standard Specification for Stream or Valve Bronze Castings
16. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings
17. ASTM B148 Standard Specification for Aluminum-Bronze Sand Castings
18. ASTM B584 Specification for Copper Alloy Sand Castings for General Applications
19. ANSI/AWWA C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
20. ANSI/AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections,

SECTION 15100 – VALVES, GENERAL

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| | Connections, and Fittings for Buried Steel Water Pipelines |
| 21. ANSI/AWWA C550 | Protective Epoxy Interior Coatings for Valves and Hydrants |
| 22. SSPC SP 2 | Hand Tool Cleaning |
| 23. SSPC SP 5 | Joint Surface Preparation White Metal Blast Cleaning |
| 24. MSS SP25 | Standard Marking Systems for Valves, Fittings, Flanges, and Unions |

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals.
- B. Shop Drawings: Shop drawings shall contain the following information:
 - 1. Manufacturer's product data including catalog cuts.
 - 2. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
 - 3. Complete information on valve operator, including size, Manufacturer, model number, limit switches, and mounting.
 - 4. Cavitation limits for all control valves.
 - 5. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
 - 6. Data in accordance with Section 16040 - Electric Motors for electric motor-operated valves.
 - 7. Complete wiring diagrams and control system schematics.
 - 8. A schedule of valves to be labeled, indicating in each case the valve location and the proposed wording for the label.
 - 9. Manufacturer's certification that products comply with the indicated requirements.

SECTION 15100 – VALVES, GENERAL

10. Manufacturer's certification that epoxy coatings have been factory tested and comply with the indicated requirements.
 11. Manufacturer's literature for flange gaskets, including compression calculation on gaskets for plastic valves and fittings.
- C. The following shall be provided in compliance with Section 01730 - Operations and Maintenance Information:
1. Manufacturer's installation and operating instructions.
 2. Manufacturer's maintenance procedures.
 3. List of special tools.
 4. Schedule of valves indicating valve identification and location.
- D. Spare Parts List: A spare parts list shall be provided with information for each valve assembly.
- E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.5 FACTORY TESTING

- A. General: Valves shall be tested in compliance with the AWWA Standards as indicated. As a minimum, unless otherwise indicated, each valve body 4 inches and larger shall be tested hydrostatically to 1.5 times its rated working pressure at 100 degrees F, for a period of 5 minutes, without showing any leaks or loss of pressure. In addition, each valve 4 inches and larger shall undergo a functional test to demonstrate satisfactory operation throughout the operating cycle, and a closure test shall be conducted at the rated water working pressure at 100 degrees F for a period of 5 minutes to demonstrate tight shut-off. Minor stem seal leakage shall not be a cause for rejection. All valves 3 inches and smaller shall undergo the manufacturer's standard test.
- B. Proof-of-Design Tests: The CONTRACTOR shall furnish the RESIDENT ENGINEER three certified copies of a report from an independent testing laboratory certifying successful completion of proof-of-design testing for all valves of diameters 10 inches and larger unless indicated otherwise in the specific valve Section. In lieu of testing the valves at an independent testing laboratory, proof-of-design testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory representative. Proof-of-design testing shall have been performed on not less than three valves, with all three units demonstrating full compliance with the test standards. Failure to

SECTION 15100 – VALVES, GENERAL

satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's model number.

1.6 FIELD TESTING

- A. Testing: Valves shall be field-tested for compliance with the indicated requirements.

PART 2 -- PRODUCTS

2.1 PRODUCTS

- A. General: Valves shall be of the size, type, and capacity indicated on the Drawings or in the Specifications. All valves shall be new and of current manufacture. All shut-off valves 6-inches in diameter and larger shall have operators with position indicators. Buried valves shall be provided with operating devices in accordance with Section 15101 - Valve and Gate Operators. Where chains would interfere with passageways, a chain hook shall be mounted on a permanent structure to maintain the passageway clear to a minimum height of 80 inches for the full passage width.
- B. Valve Operators: Unless otherwise indicated, valve operators shall be in accordance with Section 15101 - Valve and Gate Operators.
- C. Protective Coating: Protective coatings for buried and exposed valves shall be provided in accordance with Section 09800 - Protective Coating. Wet interior surfaces of all ferrous valves of diameters 4 inches and larger shall be coated in accordance with Section 09800 - Protective Coating. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant before shipment, in accordance with the Specifications. Flange faces of valves shall not be epoxy coated but shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is complete.
- D. Valve Labeling: Except when such requirement is waived in writing, a label shall be provided on all valves 4-inches and larger. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size, as indicated in Section 15030 - Piping Identification Systems, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the RESIDENT ENGINEER.
- E. Certification: Before shipment of any valve over 12 inches in diameter, the CONTRACTOR shall submit certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, and ASTM.

SECTION 15100 – VALVES, GENERAL

- F. Valve Marking: All valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

- A. General: All materials shall be suitable for the intended application. Materials not specified shall be high-grade standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise specified, valve bodies shall conform to the following requirements:
 1. Cast Iron: Cast iron valve bodies shall be of close-grained gray cast iron, conforming to ASTM A48, Class 30, or to ASTM A126.
 2. Ductile Iron: Ductile iron valve bodies shall conform to ASTM A536 or to ASTM A395.
 3. Steel: Steel valve bodies shall conform to ASTM A216, Grade WCB or to ASTM A515, Grade 70.
 4. Bronze: Bronze valve bodies shall conform to ASTM B62, and valve stems not subject to dezincification shall conform to ASTM B584.
 5. Stainless Steel: Stainless steel valve bodies and trim shall conform to ASTM A351, Grade CF8M, or shall be Type 316 stainless steel.

2.3 VALVE CONSTRUCTION

- A. Bodies: Valve bodies shall be cast, forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. All welds on welded bodies shall be performed with approved welding procedures and procedure qualifications. All welders shall be certified. Welds shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected. The flanges of valves shall comply with Section 15000 - Piping Components.
- B. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.
- C. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62,

SECTION 15100 – VALVES, GENERAL

containing not more than 5% of zinc or more than 2% of aluminum, with a minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10% in 2-inches as determined by a test coupon poured from the same ladle from which the valve stems are poured. Where dezincification is not a problem, bronze conforming to ASTM B584 may be used.

- D. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.
- E. Nuts and Bolts: All nuts and bolts on valve flanges and supports shall be in accordance with Section 05500 - Miscellaneous Metals.

2.4 GASKETS FOR PLASTIC VALVES AND FITTINGS

- A. The CONTRACTOR shall provide gaskets specifically designed for plastic valves and fittings that will develop a complete seal within the structural tolerances of the plastic flanges.

2.5 VALVE ACCESSORIES

- A. All valves shall be furnished complete with the accessories required to provide a functional system.

2.6 SPARE PARTS

- A. Two sets of packings, O-rings, gaskets, discs, seats, and bushings shall be furnished with each valve, as applicable. Furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. Also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. All spare parts are intended for use by the OWNER, only after expiration of the correction period.

2.7 MANUFACTURER'S QUALIFICATIONS

- A. Manufacturer's Qualifications: All valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

- A. General: All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

SECTION 15100 – VALVES, GENERAL

- B. Access: All valves shall be installed with easy access for operation, removal, and maintenance and to avoid interference between valve operators and structural members, handrails, or other equipment.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, assemble and install such items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

**** END OF SECTION ****

SECTION 15101 – VALVE AND GATE OPERATORS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide valve and gate operators and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS. The Work also includes coordination of design, assembly, testing and installation. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the CONTRACT DOCUMENTS.
- B. Unit Responsibility: A single manufacturer shall be made responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each type of valve and gate; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve and gate section. Unless otherwise indicated, the single manufacturer shall be the manufacturer of the valve or gate. Where two or more valve or gate operators of the same type or size are required, the operators shall all be produced by the same manufacturer.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 15100 Valves, General
 - 3. Section 16040 Electric Motors
 - 4. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/AWWA C500 Gate Valves for Water and Sewerage Systems

SECTION 15101 – VALVE AND GATE OPERATORS

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| 2. | ANSI/AWWA C540 | Power-Actuating Devices for Valves and Sluice Gates |
| 3. | NFPA/NEC NFPA 70 | National Electrical Code (as applicable) |
| 4. | ANSI/NEMA | National Electrical Manufacturers Association (As Applicable) |

1.4 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.
- B. Shop Drawings: Shop drawings of all operators shall be submitted together with the valve and gate submittals as a complete package.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. General:
 - 1. Unless otherwise indicated, all shutoff and throttling valves, and externally operated valves and gates, shall be provided with manual or power operators.
 - 2. Furnish all operators complete and operable with mounting hardware, motors, gears, controls, wiring, enclosures, solenoids, handwheels, levers, chains, extensions, and other necessary appurtenances as applicable.
 - 3. All shut-off valves 6-inches in diameter and larger shall have operators with position indicators. All operators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven operators shall be identified by unique numbers.
- B. Manufacturers: Where indicated, certain valves and gates may be provided with operators manufactured by the valve or gate manufacturer. Where operators are furnished by different manufacturers, coordinate selection to have the fewest number of manufacturers possible.
- C. Materials: All operators shall be current models of the best commercial quality materials and liberally sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

SECTION 15101 – VALVE AND GATE OPERATORS

- D. Mounting: All operators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or operator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power operators shall be equipped with position indicators. Where possible, manual operator handwheels shall be located between 42 and 54 inches above the floor or a permanent work platform. Where chains would interfere with passageways, a chain hook shall be mounted on a permanent structure to maintain the passageway clear to a minimum height of 80 inches for the fully passage width.
- E. Standard: Unless otherwise indicated and where applicable, all operators shall be in accordance with ANSI/AWWA C540.
- F. Functionality: Electric and hydraulic operators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL OPERATORS

- A. General: Unless otherwise indicated, all valves and gates shall be furnished with manual operators. Valves in sizes up to and including 3.5-inches shall have direct acting lever or handwheel operators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual operators, with a maximum operating pull of 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates, all gear-assisted valves for pressures higher than 250 psi, all valves 30-inches in diameter and larger, and where so indicated, shall have worm-gear operators, hermetically sealed and grease-packed, where buried or submerged. All other valves 4 to 24-inches in diameter may have traveling-nut operators, worm-gear operators, spur- or bevel-gear operators, as indicated, or if not indicated, as appropriate for each valve.
- B. Buried Valves: Unless otherwise indicated, all buried valves shall have extension stems to grade, with wrench nuts located within 6 inches of the valve box cover or with floor stands, position indicators, and cast-iron or steel pipe extensions with heavy valve boxes, with stay-put, hot-dip galvanized covers, and operating keys. The valve key extension shall be provided in accordance with City of San Diego Standard Drawing SDW-109 for all butterfly valves and for all gate valves when the top of the gate valve nut is 25-inches or more below ground or pavement surface. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve operators. Valve boxes shall be manufactured by Brooks type 3RT, Christy type G5, Empire type 7-1/2, or equal. Covers of valve boxes shall be permanently labeled as requested by the RESIDENT ENGINEER. 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.

SECTION 15101 – VALVE AND GATE OPERATORS

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 valve extension boxes. Box covers on water lines shall be impressed with the letter "W".
- E. Manual Worm-Gear Operator: The operator shall consist of a single or double reduction gear unit contained in a weatherproof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The operator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The operator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Operator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the operator. All gearing shall be designed for a 100% overload.

2.3 LIMIT SWITCHES

- A. General: Provide and install on all valves shown on the Process and Instrumentation Drawings as being equipped with limit switches (to indicate whether a valve is fully open or fully closed).
- B. Limit Switches shall be single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac. As shown on the Process and Instrumentation Drawings, operators shall have auxiliary transfer contacts at end position, one for valve FULL OPEN, and one for valve FULL CLOSED, or just one for valve FULL OPEN.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

SECTION 15101 – VALVE AND GATE OPERATORS

3.2 INSTALLATION

- A. All valve and gate operators and accessories shall be installed in accordance with Section 15100 - Valves, General.

**** END OF SECTION ****

SECTION 15103 – GLOBE VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide globe valves, actuators, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 01300 Submittals
 2. Section 09800 Protective Coating
 3. Section 15100 Valves, General
 4. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
1. ASTM A126 Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service
 2. ASTM A197 Standard Specification for Cupola Malleable Iron
 3. ATSM A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 4. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

SECTION 15103 – GLOBE VALVES

- | | | |
|----|-----------|--|
| 5 | ASTM B62 | Standard Specification for Composition or Ounce Metal Castings |
| 6. | ASTM B371 | Specification for Copper-Zinc-Silicon Alloy Rod |
| 7. | ASTM B584 | Standard Specification for Copper Alloy Sand Castings for General Applications |

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals, and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Globe valves for isolating and throttling service shall have threaded ends for diameters up to and including 2-inches, and flanged ends for larger diameters. Unless otherwise indicated, all globe valves shall have manual handwheel actuators.

2.2 GLOBE VALVES (2-INCHES AND SMALLER)

- A. Globe valves 2-inches in diameter and smaller shall have threaded ends, bronze bodies with union bonnets for class 150 rating. Globe valves 2-inches in diameter and smaller shall be manufactured to the following material specifications or equal:
1. Body and bonnet - Bronze, ASTM B62
 2. Disc - Teflon
 3. Disc holder and nut - Brass, or bronze ASTM B62
 4. Handwheel - Malleable iron
 5. Packing - Nonasbestos fiber with Teflon
 6. Packing nut - Bronze, ASTM B584
 7. Stem - Copper-silicon bronze, ASTM B371
- B. Manufacturers, or Equal:
1. Jenkin Valves, Figure 106B

SECTION 15103 – GLOBE VALVES

2. Stockham, Figure B-22-T
3. Walworth, Figure 3095

2.3 GLOBE VALVES (LARGER THAN 2-INCHES)

A. Globe valves larger than 2-inch diameter shall have flanged ends with cast iron bodies and a flanged bonnet for class 125 rating. Globe valves larger than 2-inch diameter shall be manufactured to the following material specifications or equal:

- | | | |
|--------------------------|---|---|
| 1. Body | - | Cast iron, ASTM A126, Class B |
| 2. Bonnet studs and nuts | - | Steel, ASTM A307 and A563, respectively |
| 3. Disc | - | Teflon |
| 4. Disc holder | - | Bronze, ASTM B62 |
| 5. Disc nut | - | Bronze, ASTM B584 |
| 6. Handwheel | - | Malleable iron for valves less than 4-inches in diameter and cast iron for valves above 4-inches in diameter. |
| 7. Packing | - | Nonasbestos fiber with Teflon |
| 8. Packing gland | - | Bronze, ASTM B584 |
| 9. Packing gland flange | - | Malleable iron, ASTM A197 |
| 10. Seat ring | - | Bronze, ASTM B62 |
| 11. Stem –Copper | - | silicon bronze, ASTM B584 |
| 12. Yoke bonnet | - | Cast iron, ASTM A126, Class B |
| 13. Yoke bushing | - | Bronze, ASTM B584 |

B. Manufacturers, or Equal:

1. Jenkin Valves, Figure 142C
2. Stockham, Figure G-514-T
3. Walworth, Figure 8914 F

2.4 GLOBE VALVES (HOSE VALVE 2 INCHES AND SMALLER)

SECTION 15103 – GLOBE VALVES

A. Angle pattern hose valve 2 inches and smaller shall be all-bronze, NPT threaded ends, inside screw-type rising stem, TFE disc, cast brass male NPT by male NHT adapter with hexagonal center wrench nut, brass cap with chain, in compliance with MSS SP-80, rated 300 WOG.

1. Body - Bronze, ASTM B-62
2. Bonnet - Bronze, ASTM B-62
3. Disc - Teflon
4. Disc holder - Bronze, ASTM B62
5. Disc nut - Brass, ASTM B16
6. Handwheel - Cast iron
7. Packing - Nonasbestos fiber with Teflon
8. Packing gland - Brass, ASTM B16
9. Packing gland flange - Malleable iron, ASTM A197
10. Seat ring - Bronze, ASTM B62
11. Stem - Bronze, ASTM B371

B. Manufacturers, or Equal:

1. Stockham, Figure B-222T
2. Crane Co., Cat No. 17TF
3. Nibco, Figure T-335-Y

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Globe valves shall be installed in accordance with Section 15100 - Valves, General and with the manufacturer's written instructions.

**** END OF SECTION ****

SECTION 15104 – BUTTERFLY VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section is to provide butterfly valves, actuators, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 09800 Protective Coating
3. Section 15100 Valves, General
4. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- B. Latest current City of San Diego Water and Municipal Sewer Approved Materials List.

- C. Except as otherwise indicated, the current editions of the following standards apply to the Work of this section:

- | | | |
|----|-----------------|--|
| 1. | ASTM A743 | Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant for General Purposes |
| 2. | ASTM A536 | Standard Specification for Ductile Iron Castings |
| 3. | ANSI/ASME B16.1 | Cast Iron Pipe Flanges and Flanged Fittings |
| 4. | ANSI/ASME B16.5 | Pipe Flanges and Flanged Fittings |

SECTION 15104 – BUTTERFLY VALVES

- | | | |
|----|------------------|---|
| 5. | ANSI/ASME B16.47 | Large Diameter Steel Flanges: NPS 26 through NPS 60 |
| 6. | ANSI/AWWA C504 | Rubber-Seated Butterfly Valves |

1.4 FACTORY TESTING

- A. Valves shall be factory tested in compliance with AWWA C504 and Section 15100 - Valves, General.
- B. Proof-of-design tests reports shall be submitted in compliance with Section 15100 - Valves, General and AWWA C504.

PART 2 -- PRODUCTS

2.1 BUTTERFLY VALVES (AWWA) – V-500, EXPOSED; V-504, BURIED

- A. General: Butterfly valves shall conform to ANSI/AWWA C504 - Rubber-Seated Butterfly Valves, subject to the following requirements. Buried, Class 250B butterfly valves shall also comply with the Standard Specification for Public Works Construction (SSPWC), Subsection 207-26.4 unless indicated otherwise. Buried Class 250 butterfly valves shall comply with SSPWC Subsection 207-26.4.1 unless indicated otherwise. Valves shall be of the size and class indicated. Flanged valves shall have Class 250 flanges, complying with ASME/ANSI B16.1, and shall be short-bodied. Shaft seals shall be designed for use with standard split-V type packing, or other acceptable seal. The interior passage of butterfly valves shall not have any obstructions or stops. The seats shall be positively mounted in the body of the valve; cartridge-type seats which rely on a high coefficient of friction for retention shall not be acceptable.
- B. Coatings: Ferrous surfaces of valves, 4-inch and larger, which will be in contact with water (exclusive of flange faces) shall be coated complying with Section 09800 - Protective Coating.
- C. Manual Operators:
 - 1. Operators shall conform to Section 15101 - Valve and Gate Operators and to ANSI/AWWA C540, subject to the following requirements. Unless otherwise indicated, all manually-operated butterfly valves shall be equipped with a handwheel (exposed) or 2-inch square operating nut and position indicator (buried). Valve key extensions shall be installed on all buried butterfly valves unless indicated otherwise in accordance with City of San Diego Standard Drawing SDW-109.
 - 2. Valves, 30 inches and larger, as well as all buried valves, shall be equipped with worm-gear operators, lubricated and sealed to

SECTION 15104 – BUTTERFLY VALVES

prevent entry of dirt or water into the housing. Operators shall require a minimum of 40 turns to rotate the disc from fully open to fully closed position.

- D. Manufacturers: As listed on the current City of San Diego Water and Municipal Sewer Approved Materials List or City approved equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. The installation shall be in accordance with Section 15100 - Valves, General.

**** END OF SECTION ****

SECTION 15105 – CHECK VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide check valves, operators, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 09800 Protective Coating
3. Section 15100 Valves, General
4. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:

- | | | |
|----|-------------------|---|
| 1. | ANSI/ASME B1.20.1 | Pipe Threads (Inch), General Purpose |
| 2. | ANSI/ASME B16.1 | Cast Iron Pipe Flanges and Flanged Fittings |
| 3. | ANSI/ASME B16.5 | Pipe Flanges and Flanged Fittings |
| 4. | ANSI/AWWA C508 | Swing-Check Valves for Waterworks Service, 2-inches through 24-inches NPS |
| 5. | ANSI/AWWA C510 | Double Check Valve Backflow - Prevention Assembly |
| 6. | ANSI/AWWA C511 | Reduced Pressure Principle Backflow Prevention Assembly |

SECTION 15105 – CHECK VALVES

7.	ASTM A48	Standard Specification for Gray Iron Castings
8.	ASTM A126	Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service
9.	ASTM B16	Standard Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines
10.	ASTM B61	Standard Specification for Steam or Valve Bronze Castings
11.	ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
12.	ASTM B148	Standard Specification for Aluminum-Bronze Sand Castings
13.	ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
14.	ASTM D1784	Standard Specifications By Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals, and Section 15100 - Valves, General.

1.5 FACTORY TESTING

- A. Valves shall be factory tested in compliance with AWWA C508, AWWA C511, and Section 15100 - Valves, General
- B. Proof-of-design tests shall be submitted in compliance with Section 15100 - Valves, General for all check valves 10-inch diameter and larger.

PART 2 -- PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

SECTION 15105 – CHECK VALVES

- A. General: Swing check valves for water, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C508, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. Swing check valves shall have a flanged cover piece to provide access to the disc. Corrosive surfaces of swing check valves 4-inches and larger, intended to be in contact with water, shall be coated complying with Section 09800 - Protective Coating.
- B. Body: The valve body and cover shall be of cast iron conforming to ASTM A126, with flanged ends conforming to ANSI/ASME B16.1, or mechanical joint ends, as indicated.
- C. Disc: The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B62.
- D. Seat and Rings: The valve seat and rings shall be of bronze to conforming ASTM B62 or B148.
- E. Hinge Pin: The hinge pin shall be of bronze or stainless steel.
- F. Manufacturers, or Equal
 - 1. American Flow Control (Darling)
 - 2. APCO (Valve and Primer Corp.)
 - 3. Kennedy Valve
 - 4. Mueller Company
 - 5. Stockham Valves and Fittings

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

- A. General: Swing check valves for air, water, oil, or gas in diameters 2-1/2 inches and smaller shall be suitable for a saturated steam pressure of 150 psi and a cold water pressure of 300 psi. Swing check valves shall have treaded ends, unless otherwise indicated, and threaded caps.
- B. Body: The valve body and cap shall be of bronze conforming to ASTM B61 or ASTM B62, and with threaded ends conforming to ANSI/ASME B1.20.1.
- C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B16, and for cold water, oil, and gas service replaceable composition discs.
- D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.
- E. Manufacturers, or Equal:

SECTION 15105 – CHECK VALVES

1. Milwaukee Valve Company
2. Stockham Valves and Fittings
3. William Powell Company

2.3 ELASTOMER CHECK VALVES, V620

- A. General: Elastomer check valves shall be rated 50 psi minimum operating pressure.
- B. Body: Elastomer type flanged, round entry area to match pipe, contoured duckbilled shaped exit, flat bottom and off-set bill design, curved bill for 18 inches and larger, valve open with approximately 2 inches of line pressure and return to CLOSED position under zero flow condition, flanges steel backing flange type, drilled to ASME B16.1, Class 125, plain-end valve attached with two Type 316 stainless steel adjustable bands, elastomer nylon-reinforced EPDM.
- C. Manufacturers:
 1. Red Valve Co., Tideflex Check Valve Series 35-1
 2. Or Approved Equal

2.4 BALL CHECK VALVES (3-INCH AND LARGER), V632

- A. General: Ball check valves 3 inches and larger shall be rated 150-pound working pressure.
- B. Body: Flanged end, iron with cleanout and sinking type hollow steel ball, vulcanized nitrile rubber exterior, flanges ASME B16.1, Class 125, suitable for vertical up flow.
- C. Manufacturers, or Equal:
 1. FLYGT Corp
 2. Flomatic Corp
 3. Golden Anderson

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All valves shall be installed in accordance with provisions of Section 15100 - Valves, General.

**** END OF SECTION ****

SECTION 15105 – CHECK VALVES

SECTION 15109 – GATE VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide gate valves and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
1. Section 01300 Submittals
 2. Section 09800 Protective Coating
 3. Section 15100 Valves, General
 4. Section 15101 Valve and Gate Operators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Latest current City of San Diego Water and Municipal Sewer Approved Materials List.
- C. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
1. ANSI/AWWA C500 Metal-Seated Gate Valves for Water Supply Service
 2. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
 3. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 4. ASTM A395 Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

SECTION 15109 – GATE VALVES

- | | | |
|----|-----------|---|
| 5. | ASTM A536 | Standard Specification for Ductile Iron Castings |
| 6. | ASTM B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| 7. | ASTM B371 | Standard Specification for Copper-Zinc-Silicon Alloy Rod |

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Buried gate valves shall be of the inside screw, non-rising stem type and shall be designed for repacking under line pressure. Valves 14-inch diameter and larger installed in vertical pipes with stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Where other operators are indicated, operators shall have counter-clockwise opening stems and shall comply with Section 15101 - Valve and Gate Operators.
- B. Interior ferrous surfaces of 4-inch diameter valves and larger in contact with water shall be coated in accordance with Section 09800 - Protective Coating.
- C. Buried ductile and gray cast iron valves shall be coated as specified in Section 15100 - Valves, General.

2.2 GATE VALVES (SMALLER THAN 3-INCH)

- A. Construction: Gate valves smaller than 3-inch diameter for general purpose use shall be nonrising stem, heavy-duty type for industrial service, with threaded or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B62. The stems shall be of bronze conforming to ASTM B62, or ASTM B371. The solid wedges shall be of bronze conforming to ASTM B62. The valves shall have malleable iron handwheels, unless otherwise indicated, and stem seals shall be of Teflon-impregnated or other acceptable nonasbestos packing. All valves shall have a pressure rating of minimum 125 psi for steam, and 200 psi cold water, unless otherwise indicated.
- B. Manufacturers, or Equal:
1. Crane Company.

SECTION 15109 – GATE VALVES

2. Milwaukee Valve Company.
3. William Powell Company.
4. Stockham Valves and Fittings.

2.3 RESILIENT-SEATED GATE VALVES (3-INCH AND LARGER)

- A. General: Resilient-seated gate valves may be provided in lieu of metal-seated double-disc or solid-disc gate valves, at the discretion of the RESIDENT ENGINEER.
- B. Construction: Resilient-seated gate valves shall conform to ANSI/AWWA C509. The valves shall be suitable for a design working water pressure of 200 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C509. The stem, stem nuts, glands, and bushings shall be of bronze, with the stem seal per ANSI/AWWA C509.
- C. Operators: Unless otherwise indicated, resilient-seated gate valves shall have manual operators, with handwheel or square nut, in accordance with Section 15101 - Valve and Gate Operators.
- D. Appurtenances: 12-inch diameter gate valves shall have a 2-inch bypass when the maximum operating pressure is 165 psi or greater, and larger gate valves shall have bypasses in accordance with AWWA C509.
- E. Manufacturers and Model: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials List.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All gate valves shall be installed in accordance with the provisions of Section 15100 - Valves, General. Care shall be taken to ensure that all valves in plastic lines are well supported at each end of the valve.

**** END OF SECTION ****

SECTION 15113 – AIR RELEASE AND VACUUM VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide air release and vacuum valves as indicated, complete and operable, including accessories and drain connections in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 15100 Valves, General

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work of this Section:
 - 2. ANSI/AWWA C512 Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Air/Vacuum Valve (AV): Air/vacuum valves shall be capable of venting large quantities of air while pipelines are being filled and allowing air to re-enter while pipelines are being drained. They shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match adjacent piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance.

SECTION 15113 – AIR RELEASE AND VACUUM VALVES

Air/vacuum valves shall be designed for minimum 150 psi water working pressure, unless otherwise indicated.

- B. Air Release Valve (AR): Air release valves shall vent accumulating air while the system is in service and under pressure, shall be of the sizes indicated on the Drawings. They shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match adjacent piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance. Air release valves shall be designed for a minimum water working pressure of 150 psi, unless otherwise indicated.
- C. Combination Air Valves (AV/AR): Combination air valves shall combine the characteristics of air/vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air, while a system is being filled or drained, respectively. They shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match adjacent piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance. Air/vacuum valves shall be designed for minimum 150 psi water working pressure, unless otherwise indicated.

2.2 MANUFACTURERS AND/OR MODELS

- A. Manufacturers and/or Models: As listed on the latest current City of San Diego Water and Municipal Sewer Approved Materials list for Combination Air and Vacuum Valves or City approved equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Air release, air/vacuum, and/or combination air valves shall be installed at high points in piping systems and where indicated on the Drawings.
- B. All valves shall be installed in accordance with the manufacturer's printed recommendations.
- C. Air release, air/vacuum, and combination air valves shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors.

**** END OF SECTION ****

SECTION 15114 – PRESSURE REGULATING VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pressure regulating valves indicated, complete and operable, with all accessories.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 15100 Valves, General
3. Section 15101 Valve and Gate Operators

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 BACK-PRESSURE SUSTAINING VALVE 3 INCHES AND LARGER, V732

- A. Hydraulically operated, diaphragm actuated, pilot controlled globe valve, ductile iron body, ASME B16.1 Class 150 flanged ends, rated 250 psi, bronze or stainless steel trim, stainless steel stem, externally mounted strainers with cocks, maintains a constant upstream pressure regardless of fluctuations in flow or downstream pressure.
- B. FDA approved fusion bonded epoxy lining and coating installed in accordance with AWWA C550.
- C. Size/Rating: 4- inch, maximum of 425 gpm, with inlet pressure of 85 psig. Outlet pressure range from 1 to 3 psig. Type 316 stainless steel tubing and fittings, 120-volt/1/60 solenoid valve, Type 316 stainless steel.
- D. Manufacturers and Products:
 1. Cla-Val; Model 50-01 8KC.

SECTION 15114 – PRESSURE REGULATING VALVES

2. Or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Pressure regulating valves shall be installed in accordance with the manufacturer's written instructions.
- B. Pressure settings shall be adjusted in the field by a direct factory employee during start-up and testing.

**** END OF SECTION ****

SECTION 15115 – MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide miscellaneous valves, including accessories and, where designated, actuators, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 15100 Valves, General
3. Section 15101 Valve and Gate Operators
4. Section 15105 Check Valves
5. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following commercial standards apply to the Work of this Section:

1. ANSI/AWWA C511 Reduced Pressure Principle Backflow Prevention Assembly
2. ANSI/AWWA C800 Underground Service Line Valves and Fittings

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

PART 2 -- PRODUCTS

2.1 BACKFLOW PREVENTER VALVES, V642

- A. General: Backflow preventers shall work on the reduced pressure principle. They shall consist of two spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves as well as test cocks at each pressure chamber. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided. The backflow preventer valves shall

SECTION 15115 – MISCELLANEOUS VALVES

be in accordance with ANSI/AWWA C511. The reduced pressure principle assembly shall be included in the latest edition of the "Approved for Service Isolation in California Public Water Systems" issued by the State of California Department of Health Services, Office of Drinking Water.

- B. Manufacturers, or Equal:
 - 1. Cla-Val Company
 - 2. Febco (CBM Industries).
 - 3. Hersey (Grinnell).

2.2 ALTITUDE VALVE, V717

- A. General: Altitude valve shall control the high water level in the reservoir without the need for floats or other devices. It shall remain open until the shut-off point is reached and designed for one-way flow. This valve shall be hydraulically operated and pilot controlled.

Altitude valve shall be globe pattern with flanged ends. The body and top plate shall be ductile iron conforming to ASTM A536 or cast steel conforming to ASTM A216. The disc retainer and diaphragm washers shall be cast iron for ductile iron valves or cast steel for cast steel valves (matching material of body). The disc guide, seat, and cover bearing shall be stainless steel conforming to grade 303 or better. The disc shall be Buna N rubber and the diaphragm shall be nylon reinforced Buna N rubber. The stem, nut, and springs shall be Type 304 stainless steel. The valve body and flanges shall be Class 150 and rated for 250 psi maximum continuous working pressure. The valve shall have a maximum working temperature of 175 degrees F. All ferrous surfaces shall be heat fusion bonded epoxy coated internally and externally.

- B. Pilot System: The pilot control shall operate on the differential in forces between a spring load and the water level in the reservoir. The desired high water level shall be set by adjusting the spring force. The pilot control shall measure the reservoir head through a sensing line connected directly to the reservoir. The pilot system shall have a bronze pilot control conforming to ASTM B62, and internal trim of Type 303 stainless steel, and Buna N synthetic rubber.
- C. Manufacturers or City approved equal: As listed on the latest City of San Diego Water and Municipal Sewer Approved Materials List for Automatic Control Valves.
- D. Model: The altitude shall be similar in all respects, including fittings, coatings and accessories to a Cla-Val Model 210-1 or OWNER approved equal.

2.3 SOLENOID VALVES

SECTION 15115 – MISCELLANEOUS VALVES

- A. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water working pressure unless otherwise indicated. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Solenoid valves in corrosive environments shall have stainless steel bodies. For chemicals and all corrosive fluids, solenoid valves with Teflon bodies and springs or other suitable materials shall be used. Enclosures shall be NEMA rated in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods. All coil ratings shall be for continuous duty.
- B. Manufacturers, or Equal:
 - 1. For general duty:
 - a. Automatic Switch Co. (ASCO), Model "RED HAT".
 - b. Magnatrol Valve Corporation.

2.4 BALL VALVES FOR GENERAL WATER SERVICE (2 INCHES AND SMALLER), V302

- A. Ball valves 2 inches and smaller shall be two-piece, standard port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, in compliance with MSS SP-110.
- B. Manufacturers, or Equal:
 - 1. Conbraco Apollo; 76F-100 Series
 - 2. Nibco; T-585 S6-R-66-LL

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Valves shall be installed in accordance with the requirements of Section 15100 - Valves, General.
- B. All valves shall be installed in accordance with the manufacturer's printed recommendations.
- C. The CONTRACTOR shall install backflow preventers in potable water lines where required by applicable codes or regulations, wherever there is any danger of contamination, and where indicated.

SECTION 15115 – MISCELLANEOUS VALVES

- D. All backflow preventers shall have piped outlets to the nearest acceptable drain, firmly supported, and installed to avoid splashing and wetting of floors.

**** END OF SECTION ****

SECTION 15117 – PUMP CONTROL VALVES

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide pump control valves, pilot-operated acutators, solenoid valves, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extend required for proper performance of the Work.
 - 1. Section 01300 Submittals
 - 2. Section 15100 Valves, General
 - 3. Section 15101 Valve and Gate Actuators

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- B. Except as otherwise indicated, the current editions of the following standards apply to the Work for this Section:
 - 1. ASTM A216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High Temperature Service.
 - 2. ASTM A536 Standard Specification for Ductile Iron Coatings.
 - 3. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

SECTION 15117 – PUMP CONTROL VALVES

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Pump control valves shall be pilot-operated valves designed for installation on the discharge of pumps to eliminate surges caused by the starting and stopping of the pump.
- B. During starting and stopping of the pumps, each pump shall pump against a closed pump control valve. When the pump is started, the solenoid control is energized and the valve shall open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve shall close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembly, which serves as an electrical interlock between the valve and the pump shall release the pump starter and the pump stops. Should a power failure occur, a built-in type check valve shall close the moment flow stops, preventing reverse flow regardless of solenoid or diaphragm assembly position. All opening and closing times shall be independently adjustable 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.
- C. A limit switch shall be provided on the valve to alarm and prevent a pump to start if the valve is open at the pump "on" call signal and also shutdown the pump if the valve does not open with a specific time delay period.
- D. An emergency closing feature shall be provided to close the valve at a controlled rate in the event of motor power loss.

2.2 PUMP CONTROL VALVES, V760

- A. General: Pump control valves shall have flanged ends. Pump control valves shall be globe pattern. The body and top plate shall be ductile iron conforming to ASTM A536 or cast steel conforming to ASTM A216. The disc retainer and diaphragm washers shall be cast iron for ductile iron valves or cast steel for cast steel valves (matching material of body). The disc guide, seat, and cover bearing shall be stainless steel conforming to grade 303 or better. The disc shall be Buna N rubber and the diaphragm shall be nylon reinforced Buna N rubber. The stem, nut, and springs shall be Type 304 stainless steel. The valve body and flanges shall be Class 150 and rated for 250 psi maximum continuous working pressure. The valve shall have a maximum working temperature of 175 degrees F. All ferrous surfaces shall be heat fusion bonded epoxy coated internally and externally.
- B. Pilot System: The pilot system shall have a bronze pilot control conforming to ASTM B62, and internal trim of Type 303 stainless steel, and Buna-N synthetic rubber.

SECTION 15117 – PUMP CONTROL VALVES

- C. Solenoid Control: Solenoid valves shall be 120 volt, 60 Hz, and of the size, type, and class as recommended by the manufacturer.
- D. Manufacturers or City approved equal: As listed on the latest City of San Diego Water and Municipal Sewer Approved Materials List for Automatic Control Valves.
- E. Model: The pump control valve shall be similar in all respects, including fittings, coatings and accessories to a Cia-Val Model 60G-08BYKC D/S 150 F 120/20 AC or RESIDENT ENGINEER approved equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All valves shall be installed in accordance with provisions of Section 15100 - Valves, General.

**** END OF SECTION ****

SECTION 16040 – ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide electric motors, accessories, and appurtenances, complete and operable, in accordance with the CONTRACT DOCUMENTS. The provisions of this Section apply to all electric motors.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 09800 Protective Coating
3. Section 11000 Equipment General Provisions
4. Section 16050 Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. ANSI/NEMA MG 1 Motor and Generator
2. ANSI/NEMA MG12.53 Motor Testing
3. ANSI/IEEE 112 Standard Test Procedure for Polyphase Induction Motors and Generators
4. IEEE 43 Recommended Practice for Testing Resistance of Rotating Machinery
5. IEEE 841 Recommended Practice for Chemical Industry Severe-Duty Squirrel Cage Induction Motors
6. IEEE RP-841 Recommended Practice for Chemical Industry Severe Duty Squirrel Cage Induction Motors

1.4 CONTRACTOR SUBMITTALS

SECTION 16040 – ELECTRIC MOTORS

- A. Shop Drawings and Catalog Data: Submit shop Drawings and catalog data submittals in accordance with Section 01300 - CONTRACTOR Submittals.
- B. Motor Data: Complete motor data shall be submitted in the shop Drawings for driven machinery. Motor data shall include:
1. Machine name and specification number of driven machine.
 2. Name of the motor manufacturer.
 3. Motor type or model and dimension Drawing. Include motor weight.
 4. Nominal horsepower.
 5. NEMA design.
 6. Enclosure.
 7. Frame size.
 8. Winding insulation class and temperature rise class.
 9. Voltage, phase and frequency ratings.
 10. Service factor.
 11. Full load current at rated horsepower for application voltage.
 12. Full load speed.
 13. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at 2 and 3/4 load.
 14. Type of thermal protection or overtemperature protection, if included.
 15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.
 16. Bearing data, with recommended lubricants for relubricatable type bearings.
 17. If used with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.
 18. Power factor at 2, 3/4 and full load.

SECTION 16040 – ELECTRIC MOTORS

19. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.
- C. Water Cooling: If water cooling is required for motor thrust bearings, the shop Drawings shall indicate this requirement.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Identical Motors: Electric motors driving identical machines shall be identical.
- B. Maximum Motor Loading: Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.
- C. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads which may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the OWNER. In addition, any changes caused by increase in motor horsepower shall be made by the CONTRACTOR at no additional cost to the OWNER; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.
- D. Exempt Motors: Motors which are for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

- A. General: All electric motors shall comply with ANSI/NEMA MG 1 - Motor and Generator.
- B. NEMA Design: Electric motors shall be NEMA Design B, (except as indicated in Equipment Specifications for motors controlled for variable speed operation and other special motors,) constant speed squirrel-cage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings.

SECTION 16040 – ELECTRIC MOTORS

- C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:
1. Motors below 1/2 hp shall be rated 115 V, single-phase, 60-Hz. Dual voltage motors rated 115/230 V, 115/208 V, or 120-240 V are acceptable, provided all leads are brought out to the conduit box.
 2. Motors 1/2 hp and larger shall be rated 230 V, or 460 V, 3-phase, 60-Hz, as required and as indicated. Dual voltage motors rated 230/460 V or 208/230/460 V are acceptable, provided all loads are brought out to the conduit box.
- D. Insulation: All three-phase motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 104 degrees F and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class.
- E. Motors in Nonhazardous Areas: Motors located in nonhazardous areas shall be totally enclosed, fan cooled with a service factor of 1.15 unless otherwise indicated.
- F. Motors in Hazardous Areas: Motors for use in hazardous areas shall have enclosures suitable for the classification shown on the Drawings. Such motors shall be UL listed and stamped as such.
- G. Motors for Use Outdoors: Motors for 25 hp and larger for use outdoors shall have space heaters. Space heaters shall be 120 VAC.
- H. High Efficiency Motors:
1. Motors with a nameplate rating of 1 hp and above shall be "high efficiency" units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112-Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.
 2. Efficiency Index: Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 12.53 - Motor Testing; these values shall be stated in the shop Drawing submittal.
 3. High efficiency motors shall conform to the guaranteed minimum, full-load efficiency requirement presented in the schedule at the end of this Section.

SECTION 16040 – ELECTRIC MOTORS

- I. Motors intended for use with variable frequency drives (VFDs) shall be compatible with the characteristics of the VFD. Motor nameplate shall specify inverter duty type motor. Motors shall have ceramic coated bearings.
- J. All two-speed motors shall be of the two-winding type.

2.3 ACCESSORY REQUIREMENTS

- A. General: Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall be gasketed. Motors less than 3 hp shall have the manufacturer's standard conduit boxes.
- B. Lifting Devices: All motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.
- C. Special Requirements: Refer to individual equipment specifications for special requirements such as motor winding thermal protection, multispeed windings, etc.
- D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated on the Drawings.
- E. Nameplate: All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

2.4 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: All single-phase 120, 208, or 230 V motors shall have integral thermal overload protection or shall be inherently current limited.
- B. Thermostats: Winding thermostats where specifically indicated shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.
- C. RTDs: Bearing RTDs and/or winding RTDs (two per phase) shall be provided where specifically indicated. RTDs shall be 100-ohm platinum.

2.5 MOTOR BEARINGS

- A. General: Bearings shall conform with the provisions of Section 11000 - Equipment General Provisions, except as supplemented or modified by the requirements of this Specification.
- B. Bearing Life: All motors greater than 2 hp shall have bearings designed for a minimum rated L-10 life of 10 years or 100,000 hours, whichever comes first.

SECTION 16040 – ELECTRIC MOTORS

- C. Fractional Horsepower: Fractional horsepower through 2-hp motors shall be furnished with Lubricated-for-Life ball bearings.
- D. Horizontal Motors Over 2 Horsepower: Motors larger than 2 hp shall be furnished with relubricatable ball bearings.
- E. Vertical Motors Over 2 Horsepower: Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- F. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve and, (where subject to freezing), insulation with heat tracing.
- G. All motors for pumps greater than 10 horsepower shall be furnished with motor shaft grounding ring.

2.6 MANUFACTURERS

- A. The CONTRACTOR's designated equipment supplier shall have the responsibility to select and supply suitable electric motors for the driven equipment. The choice of motor manufacturer shall be subject to review by the RESIDENT ENGINEER. Such review will consider the future availability of replacement parts and compatibility with driven equipment. Acceptable manufacturers include the following, or approved:
 - 1. U.S. Motors.
 - 2. Reliance Electric.
 - 3. Louis Allis (Division of Magnetek, Inc.)
 - 4. Marathon Electric Manufacturing Co.
 - 5. Siemens Energy & Automation, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.
- B. Electrical work involving connections, controls, switches, and disconnects, shall be as indicated in Division 16.

SECTION 16040 – ELECTRIC MOTORS

- C. Capacitors shall be connected to the output terminals of the motor starter. Motor overload elements shall be adjusted downwards to reflect the reduction in line current resulting from power factor correction.

3.2 FACTORY TESTING

- A. Motors rated 100 hp and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Test reports shall include heat run, performance, bearing (temperature, noise), locked rotor, speed torque, no-load saturation, surge, and megohmmeter/dielectric absorption ratio. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted.

3.3 FIELD TESTING

- A. The CONTRACTOR shall perform the following field tests:
1. Inspect each motor installation for any deviation from rated voltage, phase or frequency; or improper installation.
 2. Visually check for proper phase and ground connections. Verify that multivoltage motors are connected for proper voltage.
 3. Check winding and bearing temperature detectors and space heaters for functional operation.
 4. Test for proper rotation before connection to the driven equipment.
 5. Test insulation (megger test) of all new as well as reused motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

High Efficiency Motor Guaranteed Minimum Efficiency Requirements at Full Load

OPEN DRIP-PROOF (ODP)								
HP	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1.0			82.5	80.0	77.0	74.0	72.0	68.0
1.5	80.0	77.0	82.5	80.0	82.5	80.0	75.5	72.0
2.0	82.5	80.0	82.5	80.0	84.0	81.5	85.5	82.5
3.0	82.5	80.0	86.5	84.0	85.5	82.5	86.5	84.0
5.0	85.5	82.5	86.5	84.0	86.5	84.0	87.5	85.5
7.5	85.5	82.5	88.5	86.5	88.5	86.5	88.5	86.5

SECTION 16040 – ELECTRIC MOTORS

OPEN DRIP-PROOF (ODP)								
HP	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
10.0	87.5	85.5	88.5	86.5	90.2	88.5	89.5	87.5
15.0	89.5	87.5	90.2	88.5	89.5	87.5	89.5	87.5
20.0	90.2	88.5	91.0	89.5	90.2	88.5	90.2	88.5
25.0	91.0	89.5	91.7	90.2	91.0	89.5	90.2	88.5
30.0	91.0	89.5	91.7	90.2	91.7	90.2	91.0	89.5
40.0	91.7	90.2	92.4	91.0	91.7	90.2	90.2	88.5
50.0	91.7	90.2	92.4	91.0	91.7	90.2	91.7	90.2
60.0	93.0	91.7	93.0	91.7	92.4	91.0	92.4	91.0
75.0	93.0	91.7	93.6	92.4	93.0	91.7	93.6	91.0
100.0	93.0	91.7	93.6	92.4	93.6	92.4	93.6	92.4
125.0	93.0	91.7	93.6	92.4	93.6	92.4	93.6	92.4
150.0	93.6	92.4	94.1	93.0	93.6	92.4	93.6	92.4
200.0	93.6	92.4	94.1	93.0	94.1	93.0	93.6	92.4

SECTION 16040 – ELECTRIC MOTORS

TOTALLY ENCLOSED - FAN COOLED (TEFC)								
HP	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1.0	--	--	80.0	77.0	75.5	72.0	72.0	68.0
1.5	78.5	75.5	81.5	78.6	82.5	80.0	75.5	72.0
2.0	81.5	78.5	82.5	80.0	82.5	80.0	82.5	80.0
3.0	82.5	80.0	84.0	81.5	84.0	81.5	81.5	78.5
5.0	85.5	82.5	85.5	82.5	85.5	82.5	84.0	81.5
7.5	85.5	82.5	87.5	85.5	87.5	85.5	85.5	82.5
10.0	87.5	85.5	87.5	85.5	87.5	85.5	87.5	85.5
15.0	87.5	85.5	88.5	86.5	89.5	87.5	88.5	86.5
20.0	88.5	86.5	90.2	88.5	89.5	87.5	89.5	87.5
25.0	89.5	87.5	91.0	89.5	90.2	88.5	89.5	87.5
30.0	89.5	87.5	91.0	89.5	91.0	89.5	90.2	88.5
40.0	90.2	88.5	91.7	90.2	91.7	90.2	90.2	88.5
50.0	90.2	88.5	92.4	91.0	91.7	90.2	91.0	89.5
60.0	91.7	90.2	93.0	91.7	91.7	90.2	91.7	90.2
75.0	92.4	91.0	93.0	91.7	93.0	91.7	93.0	91.7
100.0	93.0	91.7	93.6	92.4	93.0	91.7	93.0	91.7
125.0	93.0	91.7	93.6	92.4	93.0	91.7	93.6	92.4
150.0	93.0	91.7	94.1	93.0	94.1	93.0	93.6	92.4
200.0	94.1	93.0	94.5	93.6	94.1	93.0	94.1	93.0

**** END OF SECTION ****

SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide electrical and appurtenant Work necessary for a complete and operable electrical system, in accordance with the CONTRACT DOCUMENTS.
- B. The CONTRACTOR shall make all field connections and terminations to all motors, switchgear, panels, control equipment and devices, instruments, and to all vendor-furnished packaged equipment. The requirements of this Section shall apply to all electrical items indicated in Division 16 unless otherwise indicated.
- C. The CONTRACTOR shall provide all materials and incidentals required to complete the electrical work. Typical materials which may be incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and all control wires required by vendor-furnished equipment to interconnect with other equipment all specifically indicated on the CONTRACT DOCUMENTS.
- D. All concrete work required for encasement, installation, or construction of the Work specified in Division 16 shall be 3000-psi concrete conforming to the applicable requirements of Section 03300 - Cast-in-Place Concrete; provided, that the following exceptions and supplementary requirements shall apply:
 - 1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration shall be permitted.
 - 2. A workability admixture shall be used in encasement concrete, which shall be a hydroxylated carboxylic acid type in liquid form. Admixtures containing calcium chloride shall not be used.
 - 3. Concrete for encasement of conduit or duct banks shall contain an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 02200 Earthwork
 - 3. Section 03300 Cast-In-Place Concrete

SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

4. Section 03310 Cast-In-Place Site Work Concrete
5. Section 05500 Miscellaneous Metals
6. Section 09800 Protective Coating
7. Section 13300 Instrumentation and Control
8. Section 16400 Low Voltage Electrical Service and Distribution
9. Section 16421 Surge Arrestors
10. Section 16431 Short Circuit and Coordination Report
11. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes and Standards:

NEC National Electrical Code, latest edition

B. Government Standards:

FS W-C-596E/GEN(1) Connector, Plug, Receptacle and Cable Outlet, Electrical Power

FS W-S-896E/GEN(1) Switches, Toggle (Toggle and Lode), Flush Mounted (ac)

FS WW-C-563 Electrical Metallic Tubing (EMT)

FS WW-C-581D, E Conduit, Metal, Rigid, And Intermediate; And Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated

C. Commercial Standards:

ANSI C80.1 Zinc Coated, Rigid Steel Conduit, Specification for

ANSI C80.3 Steel Electrical Metallic Tubing (EMT)

ANSI/NEMA FB 1 Fittings for Rigid Metal Conduit and Electrical Metallic Tubing, Specifications for

ANSI/UL 467 Grounding and Bonding Equipment, Safety Standard for

ASTM B3 Soft or Annealed Copper Wire

SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

ASTM B8	Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft
ASTM B33	Specification for Timed Soft or Annealed Cooper Wire for Electrical Purposes
ICEA S-95-658, NEMA WC70	Non-Shielded Power Cables Rated 2800 V or less
ICEA S-73-532, NEMA WC57	Control Cable
NEMA 250	Enclosures for Electrical Equipment (1,000 volts maximum)
NEMA PB-1	Panelboards
NEMA VE-1	Ventilated Cable Tray
UL 1	Standard for Safety for Flexible Metal Conduit
UL 6	Rigid Metal Electrical Conduit
UL 44	Rubber - Insulated Wire and Cable.
UL 360	Standard for Safety for Liquid-Tight Flexible Steel Conduit
UL 514	Electrical Outlet Boxes and Fittings
UL 886	Electrical Outlet Boxes and Fittings for Use in Hazardous Locations
UL 1072	Medium Voltage Cable, Type MV-90
D.	All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated (UL), or of an independent testing laboratory acceptable to the local code-enforcement agency having jurisdiction.
E.	In addition to other regulatory requirements, the Work of this Section shall comply with the requirements of the current edition of the Standard Specifications for Public Works Construction (SSPWC) Subsection 209-1, together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
F.	The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the OSHA Safety and Health Standards

SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

(29CFR1910 and 29CFR1926, as applicable), State Building Standards, and applicable local codes and regulations.

1.4 PUBLIC UTILITIES REQUIREMENTS

- A. The CONTRACTOR shall contact the San Diego Gas and Electric Company and verify compliance with their requirements before construction begins.
- B. Electrical service shall be as indicated by the CONTRACT DOCUMENTS.
- C. The CONTRACTOR shall verify, furnish, and install all service conduits, fittings, transformer pad, grounding devices, and all service wires not furnished by the serving utility.
- D. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service, and shall pay all charges levied by the serving utilities without additional cost to the OWNER.

1.5 PERMITS AND INSPECTION

- A. The CONTRACTOR shall obtain permits and pay for inspection fees as indicated in the CONTRACT DOCUMENTS.
- B. The CONTRACTOR shall pay for any service charges required by the utility company for connection and activation.

1.6 SUBMITTALS

- A. Shop Drawings and Catalog Data: The CONTRACTOR shall submit shop Drawings and catalog data submittals in accordance with Section 01300 - Submittals.
- B. Material Lists: The CONTRACTOR shall submit complete material lists for the Work of this Section. Such lists shall state the manufacturer and brand name of each item or class of material. The CONTRACTOR shall submit shop Drawings for all grounding work not specifically indicated.
- C. Shop Drawing Content: Shop Drawings are required for materials and equipment listed in other Sections. Shop Drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
 - 1. Front, side, rear elevations and top views with dimensional data.
 - 2. Location of conduit entrances and access plates.
 - 3. Component data.

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4. Connection diagrams, terminal numbers, wire numbers, internal wiring diagrams, conductor size, and cable numbers.
 5. Method of anchoring, seismic requirement; weight.
 6. Types of materials and finish.
 7. Nameplates.
 8. Temperature limitations, as applicable.
 9. Voltage requirement, as applicable.
 10. Front and rear access requirements.
- D. **Catalog Data:** Catalog data shall be submitted to supplement all shop Drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, noncustom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. **Materials and Equipment Schedules:** The CONTRACTOR shall furnish within 30 days, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- F. **Manuals:** The CONTRACTOR shall furnish manuals as part of the shop Drawing submittals under "Manuals" in Section 01300 - Submittals.
- G. **Record Drawings:** In addition to the record Drawings as a part of the record Drawing requirements specified in Section 01720 - Project Record Documents, the CONTRACTOR shall show depths and routing of all duct bank concealed below grade electrical installations.

1.7 QUALITY ASSURANCE

- A. **Field Control of Location and Arrangement:** The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. The CONTRACTOR shall determine the exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.
- B. **Equipment Locations:** All conduit and equipment shall be installed in a manner to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown.

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Where the Drawings do not indicate exact locations, such locations shall be obtained from the RESIDENT ENGINEER. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER.

- C. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the RESIDENT ENGINEER. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. Quality of Work: All Work, including installation, connection, calibration, testing, adjustment, and paint touchup, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
- E. Protection of Equipment and Materials: The CONTRACTOR shall furnish adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the Work and until acceptable by the RESIDENT ENGINEER.
- F. Protection: All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- G. Damaged Materials and Equipment: The CONTRACTOR shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the OWNER.
- H. Tests: The CONTRACTOR shall perform all tests required by the RESIDENT ENGINEER or other authorities having jurisdictions. All such tests shall be performed in the presence of the RESIDENT ENGINEER. The CONTRACTOR shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. The following testing shall be accomplished:
 - 1. Testing for the ground resistance value under "Grounding," below.
 - 2. Insulation resistance tests under "Wire and Cable," below.
 - 3. Operational testing of all equipment furnished and/or connected in other Sections of Division 16, including furnishing of support labor for testing.

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- I. Standard test reports for mass-produced equipment shall be submitted along with the shop Drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted for review prior to final acceptance of the project.
- J. Any test failure shall be corrected in accordance with the industry practices and in a manner satisfactory to the RESIDENT ENGINEER.

1.8 AREA DESIGNATIONS

- A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the CONTRACT DOCUMENTS as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.
- B. General Purpose Indoor Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose." Workmanship and enclosures shall comply with the general requirements of these Specifications. Electrical enclosures shall be NEMA Type 1.
- C. Outdoor and Damp Locations: In outdoor locations, raceway shall be rigid galvanized steel (GRS) conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Raceway supports such as hanger rods, clamps, and brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, and panel enclosures shall be NEMA Type 4X; enclosure shall be stainless steel. Switchboard and motor control centers shall be weatherproof NEMA Type 3R. Enclosures shall be mounted 1 inch from walls to provide an air space. Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations. "Damp locations" shall include pump room, valve vaults, and metering vaults. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- D. Splash Locations: Areas shown as splash proof shall have electrical installations as described for "outdoor locations."

1.9 CLEANUP

- A. Cleaning of Materials and Equipment: In addition to the clean-up requirements of Section 01700 - Contract Closeout, all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a nonflammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Paint touchup

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shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum cleaned before final acceptance.

- B. Cleaning of the Site: During the progress of the Work, the CONTRACTOR shall clean the premises and leave the premises and all portions of the site free of debris.

1.10 DEMOLITION AND RELATED WORK

- A. Demolition Work: The CONTRACTOR shall perform all electrical demolition work as indicated.

1. Electrical equipment and components, terminal and relay cabinets, MCCs, shall be returned to the RESIDENT ENGINEER in an orderly fashion to a designated location on the site.
2. Wire, conduit, junction boxes, fittings, supports and miscellaneous hardware removed as part of the demolition work shall not be reused and shall be disposed of by the CONTRACTOR.
3. Wires and/or conduits that need to be extended shall be terminated in a new terminal box with terminal strips. Terminal box shall be properly sized by the CONTRACTOR. In outdoor installation, the terminal box shall be NEMA 4X 304 stainless steel. Wires and terminals shall be properly identified before disconnection and after reconnection.
4. Wiring in conduits located in or under slabs shall be removed. The conduit shall be plugged level with the floor where practical. In other cases, the conduit shall be cut three inches below the finished floor and the area shall be resurfaced.
5. Openings in walls and platforms created by the removal of conduit or electrical equipment shall be patched with materials similar to those in surrounding work areas or as required to provide proper sealed conditions as reviewed and accepted by the RESIDENT ENGINEER.
6. Electrical demolition shall be as shown on the Drawings or as required by the Specifications.
7. The CONTRACTOR shall exercise due care in the removal of the equipment made surplus by this project so as not to impair its resale value or reuse. The RESIDENT ENGINEER has the right to salvage any wire or other electrical equipment removed from the project.

- B. Installation of New Equipment in Existing Structures:

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1. Installation of certain new equipment and devices is required in existing structures. For this phase of the Work, the CONTRACTOR shall remove existing equipment or devices, install new equipment as indicated, remove existing conductors from existing raceways, and pull new conductors in existing raceways, reconnect existing conductors or furnish and install new conduit and wires.
 2. The CONTRACTOR shall visit the site before bidding and carefully examine existing installation so that its proposal will reflect all the Work necessary to provide a complete installation so that the resulting installation will function as required. Include in the bid price all costs of labor and materials necessary to complete installations.
- C. Installation of Temporary Equipment:
1. To facilitate continuous operation of existing equipment, temporary equipment shall be provided where indicated. The CONTRACTOR shall submit installation and connection details for review and acceptance. Temporary installations shall provided at no additional cost to the OWNER.
 2. All cables, conduits, and fittings used in temporary connections shall not be reused to install permanent connections. Salvaged items shall be returned to the RESIDENT ENGINEER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the project shall be products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction; shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 GROUNDING

- A. General: All components of the grounding electrode system shall be manufactured in accordance with UL 467 and shall conform to the applicable requirements of NEC Article 250.
- B. Grounding Cable: Grounding cable shall be copper. Bare copper wire shall be annealed, No. 8 AWG minimum, if not called out in the Drawings.

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- C. Ground Rods: Ground rods shall conform to ANSI/UL 467 and shall be 3/4-inch diameter copper-clad steel, sectional type, joined by threaded copper alloy couplings.
- 1 Grounding connectors shall be high-strength copper alloy suitable for direct burial.
 - 2 Wire connections shall be exothermic weld by Cadweld of Erico Products for underground installation, or Burndy Hyground System using irreversible compression-type connectors for exposed aboveground installation.
 - 3 Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

2.3 UNDERGROUND DUCTS AND MANHOLES

- A. General: Where an underground distribution system is required, it shall be comprised of multiple runs of single bore metallic and nonmetallic ducts, concrete encased, with steel reinforcing bars, with underground manholes and pullboxes. When nonmetallic ducts are required, they shall be rigid Schedule 40 PVC for concrete encasement.
- 1 Manholes and pullboxes shall be of precast concrete. Concrete construction shall be designed for traffic loading.
 - a. Covers shall be traffic type, except as shown otherwise. Manholes and pullbox covers designated as "HV" covers shall be identified as "High Voltage Electric," "P" shall be identified as "Secondary Electric," "C" as "Control" and "S" as "Signal." All covers shall be watertight after installation.
 - b. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.
 - c. Manholes shall have concrete covers with 30-inch diameters lids. All covers and lids shall be bolted to cast-in-place frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be cast-iron and shall have pick holes.
 - 2 Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports and racks shall be fastened with galvanized bolts and shall be fabricated of fiber glass or galvanized steel. Porcelain insulators for cable racks shall be provided.

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3 Manholes and pullboxes shall be Brooks, Quikset, U.S. Precast, or equal. Cast-iron covers shall be by U. S. Foundry, or equal.

B. Concrete Envelope: The concrete envelope shall have a compression strength of 3000 psi in accordance with the requirements of Section 03300 - Cast-in-Place Concrete.

2.4 RACEWAYS

A. General: Raceway shall be manufactured in accordance with UL and ANSI standards and shall bear UL label as applicable.

B. Galvanized Rigid Steel (GRS) Conduit:

1 Rigid steel conduits and fittings shall be full weight, mild steel, hot-dip galvanized and zinc bichromate coated inside and outside after galvanizing.

2 Rigid steel conduit shall be manufactured in accordance with UL Standard No. 6 and ANSI C80.1.

3 Rigid steel conduit shall be manufactured by Triangle PWC, Republic Steel, or equal.

C. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be Schedule 40 PVC.

1 Nonmetallic conduits and fittings shall be UL listed, sunlight-resistant, and rated for use with 90 degrees C conductors.

2. Nonmetallic conduits and fittings shall be manufactured by Carlon, Condux, or equal.

D. Electrical Metallic Tubing: Electrical metallic tubing (EMT) and fittings shall be galvanized inside and out with an enamel coating inside and a chromate coating outside. EMT shall comply with ANSI C80.3.

E. Flexible Metallic Conduit: Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded PVC covering over the flexible steel conduit. For conduit sizes 3/4 inch through 1-1/4 inches, flexible conduits shall have continuous built-in copper ground conductor. Flexible conduit shall be requirement of UL 1. Explosion-proof flexible conduits shall be used for Class I, Div. 1, Group C&D areas.

2.5 WIRE AND CABLE

A. General: All conductors, including ground conductors, shall be copper. Insulation shall bear UL label and the manufacturer's trademark, type, voltage

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and temperature rating, and conductor size. Wire and cable shall be products of American, Rome Cable, Okonite, Houston, or equal.

B. Control Cables: All control cables shall be rated for 600 V and shall meet the following requirements:

- 1 Control wires shall consist of No. 14 gage stranded copper conductors and shall be XHHW rated for 90 degrees C at dry locations and 75 degrees C at wet locations.
- 2 Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.
- 3 Multiconductor control cable shall be rated at 600 V and shall consist of No. 14 gauge stranded copper conductors, individually insulated with a minimum of 20 mils of polyethylene, 10 mils full color coded PVC jacket over each insulated conductor, a polyester tape over assembly, and an overall PVC jacket. Multiconductor cable shall be identified by either ICEA color coding or ink imprinting. Multiconductor cables may be used in conduits or cable trays as required by the Drawings. Multipull taped control conductor assemblies may be used in conduits as approved by the RESIDENT ENGINEER.
- 4 Multiconductor tray cable shall be rated 600 V, listed by UL as Type TC cable per Article 340 of the NEC. The individual conductors shall be UL listed as Type XHHW, with a sunlight-resistant overall jacket. The cables shall pass UL and IEEE-383 ribbon burner flame tests.

C. Instrumentation Cables: Shielded instrumentation cables shall be rated at 300 V and shall comply with the following requirements:

- 1 Individual shielded cable shall consist of twisted 2 or 3 No. 16 gauge, stranded, color coded, tinned-coated copper in accordance with ASTM B 33 - Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes and B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft. Color coding shall be black-clear, or black-red-clear.
- 2 Insulation thickness shall be 32 mils of polyethylene, insulated with 2.3 mils 100% aluminum foil/polyester shield and No. 18 stranded tinned copper drain wire, all under a 32 mil PVC jacket. The shield shall be continuous and shall be grounded only at the receiving end, or as indicated.
- 3 Multi-individual shielded pair or triad instrumentation cable shall consist of individual shielded and twisted pair copper conductors with an ethylene-propylene insulation, and No. 18 AWG tinned

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stranded copper drain wire, an overall aluminum mylar shield and an overall chloro-sulfonated polyethylene compound jacket. The cables shall be suitable for cable tray installation and shall be flame retardant.

- 4 Thermocouple Extension: Extension cable shall be provided for the type of thermocouple circuit indicated. Conductors shall be 16 AWG, solid allow, with 15 mils of 90 degree C flame-retardant polyvinylchloride insulation, twisted and covered with 100% 2.35 mil aluminum polyester tape and a 20 AWG, 7-strand, tinned-copper drain wire and a 35 mil, flame-retardant PVC jacket overall. Cable shall be listed for cable tray installation.
- D. Building Wire and Cable: Building wires and cables shall be rated at 600 V and shall meet the following requirements:
- 1 Building wire shall be single conductor copper cable listed by UL as Type THHN/THWN rated 75 degrees C in wet locations and 90 degrees C in dry locations.
 - 2 Building wire No. 8 AWG and larger shall be stranded; size No. 10 AWG and smaller shall be solid or stranded.
 - 3 No wire smaller than No. 12 AWG shall be used unless specifically indicated.
- E. Cable Terminations: Cable terminations shall be in accordance with the following:
- 1 Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Stake", or equal. Threaded connectors shall be split bolt type of high strength copper alloy.
 - 2 Spring connectors (wire nuts) shall be 3M "Scotch Lok," "Ideal Wing Nuts", or equal.
 - 3 Preinsulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.
 - 4 General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip-knot", or equal. High temperature tape shall be polyvinyl by Plymouth, 3M, or equal.
 - 5 Epoxy resin splicing kits shall be 3M Scotchcoat 82 Series, Burndy Hy Seal, or equal.
 - 6 Stress cone material for makeup of medium voltage shielded cable shall be by G & W, 3M, DuPont, Raychem or equal.

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2.6 PULL AND JUNCTION BOXES

- A. General: Outlet, switch, pull and junction boxes for flush-mounting in general purpose locations shall be one-piece, galvanized, pressed steel. Ceiling boxes for flush-mounting in concrete shall be galvanized, pressed steel.
- B. Surface Mounted Boxes: Outlet, switch, pull and junction boxes where surface mounted in exposed locations shall be cast ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be pressed steel.
- C. Cast and Pressed Steel Boxes: All cast boxes and pressed steel boxes for flush mounting in concrete shall be fitted with cast, malleable box covers and gaskets. Covers for pressed steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas and finished rooms shall be stainless steel over plaster rings. Stainless steel plates shall be Sierra S-line, Hubbell, or equal. Cast boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.
- D. Floor Boxes: Floor boxes shall have checker plate covers such as O-Z/Gedney Type "YR," or equal. Surface boxes shall be O-Z/Gedney Type "YH," fully adjustable B2529 dual-level floor box by Hubbell, or equal.

2.7 CONDUIT FITTINGS

- A. General: Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings having a volume less than 100 cubic inches for use with rigid steel conduit, shall be cast or malleable nonferrous metal. Such fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall be closed with gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.
- B. Insulated Bushings: Insulated bushings shall be molded plastic or malleable iron with insulating ring, similar to O-Z Type A and B, equivalent types by Thomas & Betts, Steel City, Appleton, O-Z/Gedney, or equal.
- C. Insulated Grounding Bushings: Insulated grounding bushings shall be malleable iron with insulating ring and with ground lug, such as O-Z Type BL, equivalent types by T & B, Steel City, O-Z/Gedney, or equal.
- D. Erickson Couplings: Erickson couplings shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used. Couplings shall be 3-piece type such as Appleton Type EC, equivalent types such as manufactured by T & B, Steel City, O-Z/Gedney, or equal.

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- E. Liquid-Tight Fittings: Liquid-tight fittings shall be similar to Appleton Type ST, equivalent types such as manufactured by Crouse-Hinds, T & B, O-Z/Gedney, or equal.
- F. Hubs: Hubs for threaded attachment of steel conduit to sheet metal enclosures, where required, shall be similar to Appleton Type HUB, equivalent types such as manufactured by T & B, Myers Scrutite, or equal.
- G. Transition Fittings: Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.
- H. Expansion Fittings: Expansion fittings shall be installed wherever a raceway crosses a structural expansion joint. Such fittings shall be expansion and deflection type and shall accommodate lateral and transverse movement. Fittings shall be O-Z/Gedney Type "DX," Crouse Hinds "XD," or equal. These fittings are required in metallic and nonmetallic raceway installations. When the installation is in a nonmetallic run, a 3-foot length of rigid conduit shall be used to connect the nonmetallic conduit to the fitting.

2.8 WIRING DEVICES

- A. General: All wiring devices shall be a product of a single manufacturer and shall conform to applicable NEMA Standards for UO series. Devices shall be as manufactured by Hubbell, Sierra, Pass & Seymour, or equal. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms, where they shall be ivory. Special purpose receptacles shall have a body color as shown. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

1 Receptacles:

- a. General purpose duplex receptacles shall be grounding type, 125-volt, AC, 20-amperes, NEMA Configuration 5-20R, such as Hubbell 5252, or equal.
- b. Convenience receptacles for installation in outdoor and corrosive areas shall be NEMA 5-20R configured and shall have stainless steel or nickel plated parts and plastic parts of melanine.
 - (1) Receptacles at outdoor locations shall be UL-approved for weatherproof locations with plug inserted. These shall be Crouse-Hinds, Hubbell, Pin and Sleeve Series, or equal.

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- (2) Receptacles at damp or dry locations shall be Crouse-Hinds DS 23G, Pyle National N-1, or equal.
- (3) Receptacles at corrosive locations shall be Hubbell 52CM62 15 A, 53CM62 20 A, or equal.
- c. Ground fault interrupter (GFI) receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 mA of ground current and shall comply with NEMA WD-1-1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation. GFI receptacles shall be Hubbell GF 5252, or equal.
- d. Single 30-A receptacles shall be 2-pole, 3-wire, grounding type, 125-VAC, 30-A, NEMA Configuration 5-30R, such as Hubbell 9308, or equal.
- e. All 480-V, 400-A, 3-Phase receptacle outlets shall be 400-A, 3-wire, 4-pole, 600-V, weatherproof with spring door such as Crouse-Hinds Catalog No. AREX40428 or equal. One matching plug shall be furnished loose

2 Switches:

- a. Switches at outdoor locations shall be Crouse-Hinds DS 128, Mackworth Rees Style 3845, Joy Flexitite, or equal.
- b. Switches at damp locations shall be Mackworth Rees Style 3496, Joy Flexitite, or equal.
- c. Switches at dry locations shall be Crouse-Hinds DS 32G, Pyle National SCT-10k, or equal.
- d. Toggle switches shall conform to the following table, or equal:

	Hubbell No	Bryant No.	Hubbell No.	Bryant No.
Single Pole	1221 (brown)	4901 (brown)	1221I (ivory)	4901I (ivory)
Three Way	1223	4903	1223I	4903I
Momentary	1556	4821	1556I	4821I
Four Way	1224		1224I	

2.9 CABINETS AND ENCLOSURES

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- A. General: All electrical cabinets and enclosures housing control relays and terminal blocks shall be manufactured in accordance with NEMA Publications 250, UL Standards 50 and 508.
- 1 Relay or control, and terminal cabinets shall be NEMA 12 indoor and NEMA 4X SS outdoor. Sizes shown on the Drawings are minimum. Provide sufficient terminal blocks to terminate 25% more conductors than are shown. Interiors of cabinets shall be finished white including internal back mounting plate.
 - 2 Floor standing NEMA 12 construction shall have three-point latching mechanism operated by oil tight key-locking handle, and shall have gasketed overlapping doors. Steel construction shall be 12-gauge; construction for wall-mounted type shall be 14-gauge steel. Exterior finish shall be ANSI 61 light gray, or equal.
 - 3 Floor standing NEMA 4X enclosures shall be Type 304 stainless steel, 12-gauge, with oil-resistant door gaskets, stainless steel screws and clamps on the three sides of the door. Wall-mounted type construction shall be 14 gauge, Type 304 stainless steel.
- B. Wiring of Cabinets: Wiring of terminal cabinets, control or relay cabinets shall be accomplished with stranded copper conductor rated for 600 V and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. All others shall be No. 14 AWG. Color coding shall be as specified elsewhere in this Section. Incoming wires to terminal or relay cabinets shall be terminated on a master set of terminal blocks. All wiring from the master terminals to internal components shall be factory-installed and shall be contained in suitably sized plastic wireways having removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
- C. Terminal Blocks: All terminal block requirements shall be as manufactured by WAGO with cage clamp, Phoenix, or equal.
- D. Nameplates: Nameplate engraving shall be as shown or as directed by the RESIDENT ENGINEER. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be secured using cadmium plated steel or other corrosion resistant screws. Adhesive alone is not acceptable.
- E. Testing: Each relay or control and terminal cabinets shall be completed, assembled, wired, and tested at the factory. Test shall be in accordance with the latest UL and NEMA Standards. All cabinets shall bear UL label, as applicable.

2.10 DISCONNECT SWITCHES

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- A. Disconnect Switches: Unfused disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be padlockable in the "off" position. Switches shall have nameplates stating manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600 V. All switches rated at 100 A or larger shall have auxiliary contact for remote status indication. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty.
- B. Ratings: Switch rating shall match the horsepower requirements of the load at the particular voltage if not otherwise shown.
- C. Enclosures: Switch enclosure shall be NEMA 12 indoor and NEMA 4X SS outdoor, and shall be as manufactured by Square D, Cutler-Hammer, or equal.

2.11 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.
- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.
- C. Identification Tape: Identification tape for protection of buried electrical installation shall be a 6-inch wide red polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW."

2.12 LIGHTING AND POWER PANELBOARDS

- A. General: Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 as well as the provisions of UL 50 and 67. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-V 3-phase operation or 120/240-V for single phase operation as shown. Power panelboards shall be rated for 600 V, 3-phase operation.
 - 1 Interiors shall have solderless, anti-turn connectors and shall be constructed so that branch circuit breaker can be replaced without disturbing adjacent units or resorting to field drilling and tapping.

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Bus bars and connecting drops shall be copper. Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length. Spaces shown shall have cross connections for the maximum sized device that can be fitted.

- 2 Panelboard box shall be galvanized code grade steel with knockouts, and shall have removable end walls. All boxes or panelboard enclosures shall have gray baked enamel finish.

B. Lighting Panelboards:

1. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels. Doors in trim shall have typed circuit directory and pocket with protective clear plastic sheet. All trim and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color.
2. The number of circuit breakers and the ampere ratings shall be in accordance with panel schedules. Main circuit breaker or main lugs only shall be provided as indicated. The panelboard circuit breakers shall be group mounted and shall be molded case with 3- or 2-pole main breakers as required and branch circuit breakers with 10,000 AIC. Circuit breakers shall be thermal/magnetic type.
3. Surface mounted cabinets and trim in wet and damp areas shall be galvanized.

- C. Panelboards shall be as manufactured by Square D, Cutler-Hammer, Siemens, or equal.

2.13 PROCESS CONTROL DEVICES

- A. Pressure Switches: Pressure switches shall be as shown and specified herein.

1. The pressure ranges and exact settings of the pressure switches shall be as required. The pressure switches shall be single-pole, double-throw with adjustable differential range. Minimum differential shall be less than 10% of range. Allowable surge pressure shall be 1.5 times range or better. Each pressure switch shall have visible scale and visible contact operation. Pressure switches on systems conveying chemicals, corrosive fluids, or liquids

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containing solids, shall be protected by diaphragm seals in accordance with Section 15183 - Gauges.

- 2 Pressure switches shall be vibration protected and shall have contact rating of 10 A at 125 VAC. Pressure switches shall be snap-action switches and shall be in NEMA 4X weatherproof enclosures.
 - 3 Pressure switches shall be Mercoid, Square D, Barksdale, or equal.
- B. Liquid Level Control: Liquid level controls shall be as indicated. Level settings shall be determined by the RESIDENT ENGINEER.
- 1 Float switches shall be equipped with mercury switches actuated by displacers. Displacer suspension cable shall be stainless steel. The switch shall have a 3-inch, 150-pound mounting flange. Switch enclosure shall be NEMA 4, as required by these Specifications. The number and type of switch poles shall be as shown.
 - 2 Probe switches shall be of the induction or conduction type as indicated. Where electrode length is over 6 feet, electrode shall be stainless steel supported by a suspension cable; cable shall be terminated with vendor-supplied electrode fitting in a watertight housing. Where electrode length is less than 6 feet, electrodes shall be stainless steel rods insulated with a teflon sheath. Probe switches shall be Series 3W or 3R by B. W. Controller; C. F. Warrick; or equal.
- C. Limit Switches:
- 1 Limit switches shall be of heavy-duty, precision type, and oil-tight assembly. Enclosures shall be NEMA 4X. Contact arrangement shall be double pole. Assembly shall be able to accommodate different type of head as required.
 - 2 Limit switches shall be Square D Class 9007 Type C, or equal.
- D. Flow Switches: Flow switches shall be electronic type with single switch point circuitry and mounted in a UL-approved cast iron enclosure or an FM-approved cast aluminum enclosure. All wetted surfaces shall be Type 316 stainless steel. Power requirements shall be 120 VAC. Flow switches shall be FCI Model No. 12-64, or equal.

2.14 CONTROL STATIONS

- A. General: Control stations shall comply with NEMA Standards ICS2-216. All control stations shall be industrial type, heavy duty, oil-tight, with legend plates.
- B. Requirements: Control stations shall be as follows:

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1. Pushbutton Switch: Pushbutton switches shall be momentary type with round or square button plate. All emergency-stop pushbuttons shall have red button plates. Lock-out stop shall be momentary pushbutton with locking mechanism.
 2. Selector Switches: Selector switches shall be rated 10 A at 600 V and shall be rotary type with number of position and poles as indicated.
 3. Indicating Lights: Pilot lights shall be full-voltage, push to test type and with plastic color caps: red color for running, green for ready, and amber for failure status.
 4. Control station enclosures shall be NEMA 12 indoor and NEMA 4X SS outdoor.
- C. Manufacturers: Manufacturers shall be Square D Class 9001, Allen-Bradley Bulletin 800, or equal.

2.15 TIME CLOCKS

- A. Time clocks shall be commercial electric sealed synchronous motor type, 12 inch round dial, and shall be suitable for one minute subdivisions, a manual reset button, and a recessed black box with three pole receptacle. Time clock shall be Simplex Time Record Co. type 78-45 or Edwards Co Cat. 1882B.

PART 3 -- EXECUTION

3.1 GROUNDING

- A. General: Grounding cable shall be sized in accordance with NEC Article 250 requirements when sizes are not indicated on the Drawings. The location of ground rods shall be as indicated. The length of rods forming an individual ground array shall be equal in length and shall be of the quantity required to obtain a ground resistance of no more than 5 ohms.
- B. Equipment Ground: Ground continuity throughout the facility shall be maintained by installing an electrically-continuous metallic raceway system, or a non-metallic raceway with a grounding conductor when non-metallic raceway is permitted in the CONTRACT DOCUMENTS.
1. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Nonmetallic raceway containing dc conductors operating at more than 50 V to ground, or any AC conductors, shall contain a copper grounding conductor either bare, or green if insulated. Such conductor shall be bonded to terminal and intermediate metallic enclosures.
 2. Metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest

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switchgear ground bus. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph herein.

- C. Grounding Electrode System: Install the grounding electrode system with all required components in accordance with NEC Article 250.
 - 1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
 - 2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
 - 3. Copper bonding jumpers shall be used to obtain a continuous metallic ground.
- D. Shield Grounding:
 - 1. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer.
 - 2. Shielded instrumentation cable shall be grounded at one end only; this shall be at the Main Control Panel or otherwise at the "receiving" end of the signal carried by the cable, unless shop Drawings indicate that the shield shall be grounded at both ends.
 - 3. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

3.2 UNDERGROUND DUCTS AND MANHOLES

- A. Duct Bank Installation: The underground concrete encased duct bank shall be installed in accordance with the criteria below:
 - 1. Duct shall be assembled using high impact nonmetallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet.
 - 2. The duct shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and

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pullbox and manhole depths adjusted so that the top of the concrete envelope is a minimum of 24 inches below grade.

3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.
 4. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. The duct array shall be anchored every 4 feet to prevent movement during placement of the concrete envelope.
 5. Each bore of the completed duct bank shall be cleaned by Drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, draw a wire brush and swab through.
 6. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.
- B. Duct Entrances: Duct entrances shall be grouted smooth; duct for primary and secondary cables shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 6-inch bed of gravel as recommended by the manufacturer or as required by field conditions.
- C. Duct Bank Markers: Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches square and one foot long, shall be set 2 inches above finish grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment.
- D. Wiring: Each duct bank shall contain a No. 4/0 bare stranded copper ground wire, continuous throughout the entire duct bank. End of ground wires shall be terminated at switchgear or MCC ground bus, or transformer ground lugs.
- E. Watertight Penetrations: Duct bank penetration through walls of manholes or pullboxes, and on building walls below grade shall be watertight.
- F. Trench Backfill: Trenches containing duct banks shall be filled with select backfill with no large rocks which could damage the duct.
- G. Concrete Encased Duct Banks: Concrete encased duct bank shall terminate at building foundations. When duct enters the building on a concrete slab on grade, duct shall not be encased, but shall transition to rigid steel PVC-coated conduits on all stub-ups.

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3.3 RACEWAYS

- A. General: Raceways shall be installed as indicated, however, conduit routings shown are diagrammatic. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for the purpose intended. Factory elbows shall be used for all 3/4-inch conduit. Bends in larger sizes of metallic conduit shall be accomplished by field bending or by the use of factory elbows. All installations shall be in accordance with the latest edition of the NEC.
- B. Installation: Raceways shall be installed in accordance with the following schedule:
1. Low Voltage Raceway (control, power, and data hi-way and communications):
 - a. Rigid Schedule 40 PVC shall be used for concrete encased duct on earth.
 - b. PVC-coated galvanized rigid steel raceways shall be used on exposed locations in corrosive areas.
 - c. Galvanized rigid steel (GRS) shall be used on exposed installations in general purpose areas.
 - d. Electrical metallic (EMT) conduit shall be used in lighting and receptacle circuits on suspended ceilings or stud walls in general purpose areas.
 - e. Rigid Schedule 40 PVC shall be used for conduits embedded in concrete slab on grade and above grade.
 - f. Rigid Schedule 40 PVC shall be used for area lighting circuits and may not be concrete encased.
 - g. Schedule 40 PVC shall be used for fiber optic data hi-way system concrete encased on grade.
 - h. Galvanized rigid steel (GRS) conduit shall be used for coaxial data hi-way cables for concrete encased on grade and exposed installations.
 - i. Galvanized rigid steel shall be used in exposed installations in outdoor areas.
 2. High Voltage Raceway:

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- a. Rigid Schedule 40 PVC conduits shall be used for concrete encased duct on earth.
 - b. Galvanized rigid steel conduits shall be used on exposed installations in general purpose areas.
 - c. PVC-coated rigid steel conduits shall be used on exposed installations in corrosive areas.
 - d. Galvanized rigid steel shall be used on exposed installations in outdoor areas.
3. Analog Signal Raceways:
- a. Schedule 40 PVC conduits shall be used for concrete encased duct on earth.
 - b. PVC-coated GRS shall be used on exposed installations in corrosive areas.
 - c. Galvanized rigid steel conduits shall be used on exposed installations in general purpose areas.
 - d. Galvanized rigid steel shall be used on exposed installations in outdoor areas.
4. Exposed Raceways:
- a. Conduits shall be rigidly supported with clamps, hangers, and Unistrut channels.
 - b. Intervals between supports shall be in accordance with the National Electric Code.
- C. Conduit Terminations: Empty conduit terminations not in manholes or pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to buildings except where otherwise indicated. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in accordance with approved shop Drawings. Metallic raceways installed below-grade or in outdoor locations and in concrete shall be made up with a conductive waterproof compound applied to threaded joints. Compound shall be Zinc Clads Primer Coatings No. B69A45, HTL-4 by Crouse-Hinds, Kopr Shield by Thomas & Betts, or equal.
- D. Conduit Installations:
1. Conduit may be cast integral with horizontal and vertical concrete slabs, providing one-inch clearance is maintained between conduit

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surface and concrete surface. If said clearance cannot be maintained, the conduit shall be installed exposed below elevated slabs; provided, that in the case of slabs on grade, conduit shall be installed below the slab. Maximum size of conduit that can be cast in slab shall be 1-1/2 inches.

2. Nonmetallic conduit may be cast integral with horizontal slabs with placement criteria stated above. Non-metallic conduit may be run beneath structures or slabs on grade, without concrete encasement. In these instances conduit shall be placed at least 12 inches below the bottom of the structure or slab. Nonmetallic conduit may be buried 24 inches minimum below grade, with a 3-inch concrete cover, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red. Nonmetallic conduit shall be permitted only as required by the Specifications and in concealed locations as described above.
3. Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by nonmetallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.
4. Flexible conduit shall be used at dry locations for the connection of equipment such as motors, transformers, instruments, valves, or pressure switches subject to vibration or movement during normal operation or servicing. Flexible conduit may be used in lengths required for the connection of recessed lighting fixtures; otherwise the maximum length of flexible conduit shall be 18 inches.
5. In other than dry locations, connections shall be made using flexible liquid-tight conduit. Equipment subject to vibration or movement which is normally provided with wiring leads, such as solenoid valves, shall be installed with a cast junction box for the make-up of connections. Flexible conduits shall be as manufactured by American Brass, Cablec, Electroflex, or equal.
6. Conduit penetrations on walls and concrete structures shall be performed in accordance with the following:
 - a. Seal all raceways entering structures at the first box or outlet with oakum or suitable plastic expandable compound to prevent the entrance into the structure of gases, liquids, or rodents.

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- b. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods indicated for underground penetrations.
 - c. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement, provide such device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
 - d. Where an underground raceway without concrete encasement enters a structure through a non-waterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.
- E. Cable Tray: Cable tray shall be installed straight and true and shall be supported with cable tray hangers and supports on 8 feet centers maximum. Tray hangers and brackets shall comply with the requirements of Section 05500 - Miscellaneous Metals. Cable tray shall be grounded as described in paragraph entitled, "Grounding," above.

3.4 WIRES AND CABLES

- A. General: Conductors shall not be pulled into raceway until:
 - 1. Raceway system has been inspected and accepted by the RESIDENT ENGINEER.
 - 2. Plastering and concrete have been completed in affected areas.
 - 3. Raceway system has been freed of moisture and debris.
- B. Wire and Cables:

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1. Conductors of No. 1 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Pulling tensions on the cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
 2. Wire in panels, cabinets, and gutters shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.
 3. Cables rated 2000 V and above shall be fireproofed for their entire exposed length in manholes and handholes, using 1-1/2-inch arc-proofing tape anchored by overwrapping with glass cloth tape such as 3M Co. No. 27, Scotch, Plymouth, or equal.
- C. Splices and Terminations:
1. The CONTRACTOR shall provide, install, and terminate the conductors required for power and controls to electrical equipment and to interconnect incoming annunciator, instrumentation terminal cabinets, control and instrumentation equipment except where indicated elsewhere. There shall be no cable splices in underground manhole or pullboxes. If splices are necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet on a concrete pad.
 2. Two- and three-conductor shielded cables installed in conduit runs which exceed 2000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.
 3. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of Division 16, "control conductors" are defined as conductors operating at 120 V or less in circuits that indicate equipment status or that control the electric energy delivered to a power consuming device.
 4. All 120/208-V and 480-V branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR. All cables rated above 2000 V shall be spliced or terminated only at equipment terminals shown.
 5. Solid conductors shall be terminated at equipment terminal screws with proper care that conductor is tightly wound around screw and does not protrude beyond screw head. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

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6. Splices in 600-V wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using an epoxy resin splicing kit.
 7. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overtaped with a minimum of two layers of high temperature tape.
 8. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. Submit the proposed termination procedure as described for shop Drawings.
 9. Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtails, shall be terminated as described for control conductors.
- D. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements ICEA Publication. Factory test results shall be submitted in accordance with Section 01300 - Submittals, prior to shipment of cable. The following tests shall be the minimum requirements:
1. High potential DC test shall be performed on all cables operating at more than 2000 V to ground.
 2. Insulation resistance shall be obtained and shall not be less than the value recommended by ICEA.
 3. All cables rated at 600 V shall be tested for insulation resistance between phases and from each Phase to a ground using a megohmmeter.
 4. All field testing mentioned above shall be done after cables are installed in the raceways.
 5. Field tests shall be performed by certified test organization acceptable to the cable manufacturer. Test results shall be submitted for review and acceptance.
 6. Cables failing in the said tests shall be replaced with a new cable or repaired. Such kind of repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.
- E. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed prior to placing all cables in service.

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3.5 PULL AND JUNCTION BOXES

- A. Sizing: Pull and junction boxes shall be sized in accordance with the requirements of the NEC.
- B. Outlet Boxes: Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are required, they shall have screw covers.
- C. Requirements: Pullboxes shall be installed when conduit run contains more than three 90-degree bends and runs exceed 200 feet.

3.6 LIGHTING AND POWER DISTRIBUTION PANEL BOARDS

- A. The circuit description as indicated on the Panel Schedule shall be typed on the circuit directory.
- B. Panel boards shall be tested for proper operation and function.

3.7 CABINETS AND ENCLOSURES

- A. Cabinets shall be set plumb at an elevation that will cause the maximum circuit breaker height to be less than 66 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flushed and serves as a "ground" for plaster application.
- B. All factory wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.

3.8 CONCRETE HOUSEKEEPING

- A. Housekeeping Pads: Concrete housekeeping pads shall be provided for all floor standing electrical equipment. Housekeeping pads for all equipment, including future units, shall be 2 inches above surrounding finished floor or grade and 2 inches larger in both dimensions than the supported equipment, unless otherwise indicated.
- B. Housekeeping Curbs: Concrete housekeeping curb shall be provided for all conduit stub-up in indoor and outdoor locations, not concealed by equipment enclosures. Such curb shall be 3 inches above finished floor or grade.

3.9 EQUIPMENT ANCHORING

- A. Anchors: Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions.

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Transformers hung from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.

- B. Leveling Channels: Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations.
- C. Anchoring Methods: Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as required for shop Drawings in Section 01300 - Submittals.

3.10 CABLE AND EQUIPMENT IDENTIFICATION

- A. General: The completed electrical installation shall be provided with adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.
- B. Cable: Assign each control and instrumentation wire and cable a unique identification number. Said numbers shall be assigned to all conductors having common terminals and shall be shown on all shop Drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes:
 - 1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers indicated on the Drawings.
 - 2. All 120/208-V system feeder cables and branch circuit conductors shall be color coded as follows: Phase A-black, Phase B-red, Phase C-blue, and Neutral-white. The 480/277-V system conductors shall be color coded as follows: Phase A-brown, Phase B-orange, Phase C-yellow, and Neutral-gray. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.
 - 3. General purpose ac control cables shall be pink. General purpose dc control cables shall be blue.

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4. All spare cables shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
 5. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.
- C. Equipment: Equipment and devices shall be identified as follows:
1. Nameplates shall be provided for all panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates shown, control devices shall be equipped with standard collar-type legend plates.
 2. Control devices within enclosures shall be identified similar to the paragraph above.
 3. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.
 4. Toggle switches which control loads out of sight of switch, and all multiswitch locations of more than two switches, shall have suitable inscribed finish plates.
 5. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.
 6. Provide typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.
 7. Install identification tape directly above buried unprotected raceway; install tape 8 inches belowgrade and parallel with raceway to be protected. Identification tape is required for all buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

**** END OF SECTION ****

SECTION 16200 - ENGINE GENERATOR

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The Work of this Section includes providing one complete engine-generator unit mounted on a structural steel base mounted on a trailer, set on a concrete foundation block. This unit includes, but is not limited to, a diesel engine, generator frame-mounted generator control panel, starting and control equipment, radiator, fan, exhaust system, exhaust piping, intake air cleaner and piping, oil pumps, lubricating oil, air intake system and engine jacket water heater, and all other parts, instruments, and auxiliary equipment necessary to make a complete unit. The engine-generator shall be a heavy-duty, industrial type, suitable for a standby operation in the event of a utility outage under the conditions indicated, electric motor started, with engine-mounted radiator. The generator shall be a revolving field, brushless, synchronous type. The engine shall be started and stopped in both manual and automatic modes by means of control signals from the engine-generator switchboard control section. The engine-generator, piping, and all accessories shall be coated with the manufacturer's standard finish. The engine-generator manufacturer shall provide an automatic load transfer switch as specified in Section 16412, Automatic Transfer Switch. The engine-generator shall be provided and equipped with a sound attenuating, weather proof enclosure which meets the requirements of local and regional noise regulations.
- B. The expected minimum ambient temperature at the project site is 30 degrees F and the expected maximum ambient temperature is 100 degrees F. The altitude of the project site is 725 feet. Relative humidity is 0 to 95 percent.
- C. The Work also requires that one single manufacturer be made responsible for furnishing the Work of this Section but without altering or modifying the CONTRACTOR's responsibilities under the CONTRACT DOCUMENTS. The CONTRACTOR shall furnish a written, notarized certification signed by an officer of the manufacturing corporation, stating that the unloading, installation, testing, and inspection of the materials of all major equipment components and instrumentation meet or exceed the values indicated herein and in the referenced standards.
- D. All equipment shall be new and unused, of current domestic production of a national firm which manufactures the engine-generator set as a matched unit, and whose quality control program complies with ISO Standards and that is certified to ISO-9001. The manufacturer together with its authorized local representative, shall have full responsibility for the performance of the generator set and its accessories. Unit shall be designed for outdoor installation.

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- E. Supplier shall maintain a parts and service facility within 35 miles of the installation site, employ factory trained technicians, and offer 24-hour emergency service. Supplier shall be the authorized dealer of a manufacturer offering standard production equipment built and prototype tested in accordance with NFPA 110, and shall be authorized to administer the warranty for all components of the emergency generator system 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 Submittals
2. Section 05500 Miscellaneous Metals
3. Section 09800 Protective Coating
4. Section 11000 Equipment General Provisions
5. Section 16050 Basic Electrical Materials and Methods
6. Section 16400 Low Voltage Electrical Service and Distribution
7. Section 16412 Automatic Transfer Switch
8. Section 16485 Local Control Panels
9. Division 13 – Special Construction
10. Division 16 – Electrical

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

- A. It is the intent of these specifications to secure for the purchaser a generator set of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. The equipment supplied and the installation shall meet the applicable requirements of the following codes and regulations:

CAC Title 24 State of California Administration Code, Title 24, Building Standards

CAC Title 19 State of California Administration Code, Title 19, Public Safety

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Code of Federal Regulations (CFR)	CFR 1910 Occupational Safety and Health Standards
EGSA 100B	Performance Standard for Engine Cranking Batteries Used with Engine Generator Sets
EGSA 100C	Performance Standard for Battery Chargers for Engine Starting Batteries and Control Batteries
EGSA 100D	Performance Standard for Generator Overcurrent Protection 600 Volts and Below
EGSA 100E	Performance Standard for Governors on Engine Generator Sets
EGSA 100F	Performance Standard for Engine Protection Systems
EGSA 100G	Performance Standard for Generator Set Instrumentation, Control and Auxiliary Equipment
EGSA 100M	Performance Standard for Multiple Engine Generator Set Control Systems
EGSA 100S	Performance Standard for Transfer Switches for Use with Engine Generator Sets
EGSA 100T	Diesel Fuel Systems for Engine Generator Sets with Above Ground Steel Tanks
EGSA 100M	Performance Standard for Multiple Engine Generator Set Control Systems
IEEE 115	Synchronous Machines
IEEE 126	Speed Governing of Internal Combustion Engine-Generator Units
IEEE 421.1	Definitions for Excitation Systems for Synchronous Machines
IEEE C37.2	Electrical Power System Device
NEMA 250	Enclosures for Electrical Equipment (1000 volts Maximum)
NEMA AB 1	Molded Case Circuit Breakers and Molded Case Switches
NEMA MG 1	Motors and Generators
NEMA PB 2	Deadfront Distribution Switchboards

SECTION 16200 - ENGINE GENERATOR

NEMA/ICS 1	Industrial Control and Systems
NEMA/ICS 2	Controllers, Contactors and Overload Relays, Rated not more than 2000 Volts AC or 750 Volts DC
NEMA/ICS 2-447	Standard for Automatic Transfer Switches
NEMA/ICS 6	Industrial Control and Systems Enclosures
NFPA 20	Centrifugal Fire Pumps
NFPA 30	Flammable and Combustible Liquids Code
NFPA 37	Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	National Electrical Code
NFPA 70B	Electrical Equipment Maintenance
NFPA 99	Health Care Facilities
NFPA 101	Life Safety Code
NFPA 110	Emergency and Standby Power Systems
UL 142	Steel Above Ground Tanks
UL 429	Electrically Operated Valves
UL 489	Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 1008	Automatic Transfer Switches
UL 1236	Battery Chargers for Charging Engine-Starter Batteries
City Noise Ordinance	City Ordinance Section 59.5.0401

1.4 CONTRACTOR SUBMITTALS

- A. All of the material required for submittal under this Section shall be furnished in one complete package. The package shall be submitted in accordance with Section 01300 - Submittals. The CONTRACTOR shall submit the proposed factory testing program to the RESIDENT ENGINEER for review and comment at least 60 days before testing is scheduled to begin. The CONTRACTOR shall submit shop drawings, earthquake design data, test reports, manufacturers'

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certified reports, technical data, and tool and accessories to the extent required in this Section. In addition to the items required in Section 11000 - Equipment General Provisions, submittal data shall be required as follows:

1. General:
 - a. An affidavit attesting to the identity of the supplier having unit responsibility, as indicated above.
 - b. Bill of Material, covering all equipment submitted.
 - c. Qualifications of the engine-generator manufacturer and of the authorized distributor. ISO-9001 certification. 24-Hour emergency service capability.
 - d. Manufacturer's published rating sheet. NFPA-110 prototype test verification. Altitude and temperature derating procedures. Frequency and voltage regulation. Cooling system capability. Full rated load pickup capability.
 - e. Outline installation drawings (plans and sections) for complete engine-generator set showing the location, size and other pertinent details of each piping, electrical and monitoring connection.
 - f. Detailed factory brochures of the complete emergency generator set including factory published specification sheets and catalog cut sheets.
 - g. Details of plans for shipment of the equipment to the project site. Weight of complete unit.
 - h. Weight of heaviest part.
 - i. Foundation plan with anchor bolt details and dimensions.
 - j. Spring-type engine-generator unit vibration isolators with seismic restraints.
 - k. Torsional analysis
 - l. Exhaust emission analysis for the engine-generator set to satisfy air pollution control requirements.
 - m. Vibration isolators for accessories.
 - n. All flexible connectors.
 - o. Piping, cooling air and exhaust connections.
 - p. Exhaust silencer and attenuation rating.
 - q. Battery set and battery charger.
 - r. Electrical starting system, including batteries and battery rack.
 - s. Fuel diesel system, including alarms and indicator devices, dimensional data, shutoff valves, fuels strainer, flexible hose, and manual switch-over.
 - t. Fuel storage system. Compliance with UL-142. Alarm and indicator devices. Dimensional data. Fuel capacity and hours of operation possible. Seismic restraint devices and calculations for fuel tank.
 - u. Remote annunciator panel. Dimensional data.

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- v. Generator set enclosure. Material and construction details. Dimensional data. Sound attenuation data when specified. Compatibility with cooling requirements of generator set at rated load and specified ambient conditions.
 - w. Legends for all devices on all diagrams.
 - x. Nameplate data including the nameplate material, heights of letters, inscriptions and method of mounting.
 - y. Testing procedures.
 - z. Warranty certificate and administration authorization.
 - aa. Certified performance rating from the engine-generator manufacturer with the engine-generator set equipped with all auxiliary equipment as specified and needed and operating on the specified diesel fuel. The certified performance rating shall be at 80°F ambient air temperature, .08 power factor, project site evaluation and other conditions, and shall include certified maximum noise level readings under full rated load at points three (3) feet and fifty (50) feet from the unit.
 - bb. Information on at least one successfully performing engine-generator unit of comparable size and complexity constructed in the recent past with names, telephone numbers, and addresses of owners.
 - cc. Jacket water heater system and connection diagram.
2. Engine:
- a. Torque, brake horsepower and fuel consumption curves for the indicated conditions and various loads.
 - b. Engine weight.
 - c. Complete fuel piping schematics showing the relative position of all valving and appurtenances.
 - d. Details of governing system.
 - e. Catalog data.
 - f. Ventilation and combustion air CFM requirements.
3. Generator:
- a. Weight.
 - b. Stator and field ratings including temperature rise at full and overload conditions.
 - c. Complete description of insulation system.
 - d. Complete wiring diagrams for the generator, engine control system, voltage regulation and excitation systems, showing wiring and terminal identification systems.
 - e. Generator impedances: X_d , X_q , X_d' , X_d'' , X_2 , X_o , X_p , r_a , r_1 , r_2
 - f. Generator current decrement curve.
 - g. Generator motor starting capability.

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- h. Generator thermal damage curve.
 - i. Catalog data.
 - 4. Control Panel and Automatic Controls:
 - a. Panel enclosure layout drawings.
 - b. Complete step-by-step functional description of the operation of each control circuit.
 - c. Complete elementary, connection and circuit diagrams, including interconnection wiring diagrams for all equipment, and automatic system logic diagram.
 - d. Conduit stubout locations.
 - e. Complete catalog information of all parts and components of electrical equipment.
- B. Earthquake Design Data. Submit with the shop drawings complete seismic calculations, details of construction, and method of attachment for generator set mounting to base and for anchor bolts for anchoring base to concrete slab showing compliance with paragraph 2.12 herein. The calculations and details shall be signed by a Professional Engineer who has demonstrated proficiency in Structural Engineering or Civil Engineering and is registered in the State of California.

1.5 OPERATIONS AND MAINTENANCE INFORMATION

- A. The following shall be submitted in compliance with Section 01730 - Operations and Maintenance Information:
 - 1. Operation and maintenance information as indicated for each separate subassembly and separately furnished item of equipment provided under this Section. Information on the following items shall be specific to the entire engine generator furnished under this Section: startup, operating, shut down, short and long-term inactivation, and preventive maintenance procedures; lubricant list with recommended lubrication intervals; spare parts list; tool list; and overhaul instructions.
 - 2. Copies of all factory engine tests, in quintuplicate, certified by an officer of the manufacturing corporation.
 - 3. Copies of all generator test documentation, in quintuplicate, certified as above.
 - 4. Point-to-point wiring diagrams for all controls.
 - 5. Details of the engine starting system, including electrical schematics.

1.6 TOOLS AND ACCESSORIES

- A. The CONTRACTOR shall furnish and deliver all special tools, instruments, accessories, and special lifting and handling devices shown in the approved

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instruction manuals. Unless otherwise specified or directed by the RESIDENT ENGINEER, the items shall be delivered to the OWNER, with written transmittal accompanying each shipment, in the manufacturers' original container labeled to describe the contents and the equipment for which it is furnished. The CONTRACTOR shall deliver a copy of each transmittal to the RESIDENT ENGINEER for record purposes.

1.7 REGULATORY REQUIREMENTS

- A. The engine shall be specifically designed to minimize the discharge of gaseous pollutants to the atmosphere and meet all of the County of San Diego Air Pollution Control District (APCD) standards.
- B. Permitting: The City shall be responsible for obtaining all permits to operate the diesel generator including the APCD. The CONTRACTOR shall obtain the latest requirements and supply equipment that will meet these requirements. The CONTRACTOR shall ensure that any and all required testing is done that is necessary to acquire the permits. The OWNER will pay for all permit fees. The manufacturer shall furnish a certificate attesting to the fact that the unit furnished will be in compliance with requirements of the APCD. Fuel control system shall be specifically designed to operate on diesel gas.
- C. Specific pollutant limitations, applicable at all loads, shall be as follows:
 - Maximum
Emission Rate,
Pollutant pounds per hour
Oxides of nitrogen []
Carbon monoxide []
Non-methane hydrocarbons []
- D. Noise Control
 - 1. The far-field sound pressure level with the diesel engine-generator unit operating at full rated load shall not exceed the provisions of the City of San Diego Municipal Code, Noise Abatement and control, and the County of San Diego Code of Regulatory ordinances, Noise Abatement and control when measured at any point of the facility property line and at a point five (50 feet above the ground level of the measuring point. In the event of conflict, the most stringent requirement shall apply.
 - 2. For engine-generator units housed inside buildings, the equipment near-field sound pressure levels shall comply with CAL-OSHA and US-OSHA regulations in effect at the time of the award of this contract for a two (2) hour continuous exposure when using ear protection.

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3. The CONTRACTOR shall provide suitable silencers, acoustical treatment of the equipment, acoustical louvers, weather proof acoustical enclosures, and other equipment and/or materials to achieve the specified sound pressure level requirements at no additional cost to the City.

1.8 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustments: An authorized service representative of the manufacturer shall visit the site for not less than 4 days provided in three site visits and shall witness the following:
 1. Unloading and placement.
 2. Installation.
 3. Inspection, checking and adjusting.
 4. Startup and field testing for proper operation.
- B. Instruction of OWNER's Personnel: At no additional cost to the OWNER, the manufacturer's authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the system including step-by-step troubleshooting procedures with necessary test equipment for not less than 4 days, provided in two site visits. In addition, the OWNER's personnel will be present during field testing and shall receive instruction on the startup and testing procedure. The CONTRACTOR shall give the RESIDENT ENGINEER written notice of the proposed field testing period at least two weeks prior to the commencement of field testing.
- C. The manufacturer shall submit a written training program to the RESIDENT ENGINEER for approval. Training shall include 8 hours of classroom time instruction and 4 hours of equipment-demonstration time. Training shall not start until 30 days after written approval by the RESIDENT ENGINEER. A minimum of 5 trainees of each respective trade shall receive a training manual specific to their trade, as follows:
 1. Mechanics
 2. Electricians
 3. Instrument Machinery
 4. Operators

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The training manuals will be retained by the trainees and will not returned to the manufacturer.

- D. Manufacturer's Certified Reports: The manufacturer or its authorized representative shall submit a notarized written report certifying that: (1) the equipment was properly installed, wired and connected, (2) the equipment is in accurate alignment, (3) the manufacturer or its authorized representative was present when the equipment was placed in operation, (4) the manufacturer or its authorized representative checked, inspected and adjusted the equipment as necessary, (5) the equipment was operated under full load conditions and operated satisfactorily, (6) the exhaust emission and noise level is in compliance with applicable regulations, and (7) the equipment is fully covered under the terms of the warranty.
- E. Service: Maintain a service center capable of emergency maintenance and repair at the project site within eight hours maximum response time.

1.9 FACTORY TESTING

- A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for one RESIDENT ENGINEER-designated inspectors for 1 days required to complete such inspections or observations exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than 50 miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400 - Quality Control. The CONTRACTOR shall notify the RESIDENT ENGINEER two weeks in advance of the factory testing.
- B. Before delivery to the job site, the products shall be tested at the factory and witnessed by the RESIDENT ENGINEER. The test shall verify that products are free of any defects, and verify guaranteed performance. The CONTRACTOR shall not ship equipment before approval of the RESIDENT ENGINEER.
- C. The engine-generator set shall be subject to both static and operating tests as described below:
 - 1. Static Testing. The entire unit, including control panels and accessories, shall be set up and tested, using static methods to ensure that all safety devices and control circuits are properly installed, aligned, and connected. All trim piping shall be pressure tested, and all regulators and solenoid valves shall be tested for proper function.

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2. Operating Tests. The complete unit shall be set up in a test cell and operated to determine its characteristics under various loads. The engine tests shall be conducted in accordance with applicable portions in ASME PTC 17. The generator tests shall be conducted in accordance with applicable portions of the test procedure in NEMA MG-1, through the use of dry type load banks. The test shall include full load operating test of at least 8 hours. Records, in addition to the information required by ASME PTC 17 and NEMA MG-1, shall include the average starting time for not less than 19 cold starts, test cell temperatures, the and number of cranking cycles before successful start. The CONTRACTOR shall submit four copies of the certified test reports in typed form to the RESIDENT ENGINEER.

D. Factory Prototype Testing: The system manufacturer must certify that engine, generator, controls, and switchgear have been tested as complete system of representative engineering models (not on equipment sold). Submit a certified prototype test report.

Prototype testing shall include:

1. Fuel consumption at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full load.
2. Exhaust emissions.
3. Mechanical and exhaust noise.
4. Governor speed regulation at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full load; and during transients.
5. Motor starting kVA
6. Generator temperature rise in accordance with NEMA MG1-22.40.
7. Harmonic analysis, voltage waveform deviation and telephone influence factor.
8. Generator short circuit capability.
9. Cooling system performance.
10. Generator revolving field assembly for 2 hours at 150% overspeed and 70 degree C, and each production unit tested at 125% overspeed at room temperature.

1.10 SHIPMENT

A. The equipment to be furnished under this Section shall be shipped to the site with weathertight covers on all piping and electrical connections. All shaft housing penetrations shall be sealed in a manner which shall protect against damage from the elements and deterioration of the equipment due to moisture, corrosive gases, dirt and debris. Additionally, each individual shipment shall be packaged in a manner designed to protect the equipment against damage caused by sudden acceleration or deceleration.

1.11 QUALIFICATIONS

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- A. The manufacturer shall specialize in engine-generators and demonstrate a minimum of one recently constructed, successfully performing installation of comparable size and complexity. The CONTRACTOR shall provide a list of the size and type of the manufacturer's generating sets that have successfully operated for not less than the past two years. One-of-a-kind fabrications will not be acceptable. Equipment of comparable size and complexity shall have the following characteristics:
- B. The manufacturer of the engine-generator set shall be the actual manufacturer of either the generator or the prime mover and shall have a minimum of 10 years experience producing engine-generator sets of similar size.
- C. The manufacturer shall own and operate a permanent test facility where the required factory tests shall be performed.
- D. The engine-generator set shall be a standard product in current production of the manufacturer.
- E. The engine-generator set, including all components, shall be new, fabricated, assembled complete, tested and shipped by the manufacturer.

1.12 WARRANTY

- A. The manufacturer shall provide a warranty against defects in material, workmanship, and operation for 5 years or 3000 hours of operation from the date of final acceptance of the project. The CONTRACTOR shall furnish the original warranty. There shall be one source responsibility for warranty, parts and service through a local representative with factory-trained service personnel. The warranty shall include free replacement parts for year period (3000 hours) and free labor for the first two years. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor.

1.13 QUALITY ASSURANCE

- A. The equipment furnished shall comply with NFPA 70, NFPA 99, and NFPA requirements for Level 2 emergency power supply system.

1.14 MAINTENANCE CONTRACT

- A. Furnish service and maintenance of the engine generator system for one year from date of Substantial Completion.
- B. Generator supplier shall perform the following reliability inspections and maintenance services during regular business hours on an annual basis during the term that this agreement remains in effect. Services shall be

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provided at no additional charge to owner for the first year beginning with final acceptance of the installation. Extension of the agreement for additional years shall be offered by the generator set supplier and shall be at the option of OWNER.

- C. Annual reliability inspections will include:
1. Inspect overall appearance and condition of the generator set installation, enclosure, fuel storage, etc.
 2. Batteries will be cleaned, electrolyte levels and specific gravity will be checked, and reports made of any action necessary for recharging or replacing.
 3. Fuel tank will be inspected for defects. Critical fuel levels will be noted and recommendations for refueling will be made when necessary.
 4. Equipment will be checked for fuel, oil or coolant leaks.
 5. Fuel and governor system will be checked for proper operation.
 6. All fluid levels will be checked and topped-off as necessary. (Fuel not included)
 7. Air cleaners will be checked and if necessary recommendations made for replacement.
 8. Owners/operators present will be instructed on operating and upkeep procedures to follow between regular calls by service personnel.
 9. Engine block heater and associated plumbing will be checked for proper operation.
 10. All belts and cooling system hoses will be checked. Owner will be advised of their condition.
 11. Check electrical connections and wiring for any abrasion or chaffing.
 12. After all of the above inspections have been completed; service personnel will run equipment, record all operational gauges, check voltage and frequency outputs and engine electrical and mechanical shutdowns.
 13. All instruments will be checked for proper operation.
 14. Equipment will be checked for abnormal vibration and noises.
 15. Automatic transfer switch will be inspected; all moving parts will be checked and cleaned if possible.
 16. Technician will clean equipment and paint, if necessary, to prevent corrosion and preserve reasonable overall appearance.
 17. Report condition of system and, if discrepancies are found, provide a proposal for repairs to insure the stand-by reliability of the equipment.

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- D. Annual Maintenance Services (once per year) will include the following:
1. Perform reliability inspections as noted above.
 2. Change engine lubricating oil and oil filters.
 3. Check air cleaner element and advise if replacement is required.
 4. Take oil sample and coolant sample for analysis by fluid testing laboratories.
 5. Perform a 4-hour resistive load bank test at 100% rated load.
 6. Service the automatic transfer switch
 7. Dispose of hazardous waste from service in accordance with all legal requirements including the maintenance of records regarding disposal.
 8. If there are any problems encountered during the planned maintenance service visit they will be brought to the attention of the owner/operator. Repairs will only be made after proper authorization from owner/operator is given to the technician. Labor will be billed at reduced special contract labor rates depending upon when the service is to be performed.
 9. Service organization shall provide proof of the following insurance coverage by furnishing a certificate naming the San Diego Gas & Electric as additional insured.

PART 2 -- PRODUCTS

2.1 RATING

- A. Unit shall be rated at 200 KW, .8 PF, 250 KVA, for continuous standby operation during any utility power failure. Rating shall be verified by published specification sheets of its nationally recognized manufacturer. Generator set shall be capable of accepting rated load in one step in accordance with NFPA-110 Para. 3-5.3.1.
- B. System voltage shall be 277/480, 3 phase, 4 wire, 60 Hertz, with full load current capacity of 300 amps. Generator shall be 12 lead type for future voltage changes
- C. Generator set shall be Kohler model 200REOZJF, comparable models by Caterpillar, Onan, or equal. Submission of data substantiating a request for the substitution of "an equal" item shall be made within 35 days from date of contract.
- D. Rating specified in paragraph A is the minimum capacity for steady state load. The generator set shall also be capable of starting the following transient loads, in the order shown, with a maximum allowable instantaneous voltage dip of 20 percent. Voltage dip calculations, or computer simulation, shall verify generator model selection.

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Number	Load Description	Starting Method
1	40 hp Pump Motor	VFD
1	60 hp Pump Motor	VFD
1	40 hp Pump Motor	VFD

2.2 ENGINE

- A. General: The engine shall be equipped with a fuel system suitable for operation on DF-2 diesel fuel with a sulfur content not to exceed 0.05 percent by weight. Fuel system shall include an engine driven transfer pump, replaceable filter, fuel purifier, and flexible fuel lines. Fuel system shall comply with the requirements of NFPA-37 and NFPA-110 Paragraph 5-9.
- B. The engine shall be equipped with a fuel system suitable for operation on DF-2 diesel fuel with a sulfur content not to exceed 0.05 percent by weight. Fuel system shall include an engine driven transfer pump, replaceable filter, fuel purifier, and flexible fuel lines. Fuel system shall comply with the requirements of NFPA-37 and NFPA-110 Paragraph 5-9.
- C. Crankshaft: The crankshaft shall be made from a single heat treated forged steel block or of a two-piece design and shall be sized to provide a liberal margin of safety against abnormal strains. Journals shall be hardened and micropolished. The shaft shall be statically and dynamically balanced after fabrication. If of two-piece design the crankshaft shall be machined and balanced as a single unit.
- D. Cylinders: Cylinders may be cast individually or in one block. If in one block, removable jacket liners shall be provided, fitted with integral water jackets with suitable connections to inlet and outlet to eliminate the presence of water in the cylinder block. All cylinder liners shall be finished to give a straight bore, shall be carefully machined and honed, and shall be chrome-plated, or equivalent, on the water side to reduce cavitation damage.
- E. Pistons: Pistons shall be of the oil-cooled trunk type, made of close-grained cast iron or aluminum alloy, accurately machined to size. The piston shall be long in proportion to the diameter and shall be provided with a sufficient number of piston rings to ensure maximum compression and to minimize oil consumption.
- F. Valves: Inlet and exhaust valves shall be precision machined and shall be made of top grade heat-resisting material. Valve seats shall be replaceable, made of heat-resistant high alloy steel. Valves shall be of large diameter to produce the greatest volumetric efficiency and adequate scavenging of the cylinders in order to keep valve maintenance to a minimum. All valve mechanisms shall be constructed so as to provide positive action with utmost rigidity. Renewable

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hardened steel inserts shall be provided for all valve stem guides. Valve seats shall be replaceable and made of a hardened steel selected specifically for high temperature service.

- G. Exhaust Manifolds: Exhaust manifolds shall be fully insulated and, if in pairs, shall be joined to provide a single exhaust outlet for the engine.
- H. Materials: The engine shall be constructed of the following materials:

<u>Component</u>	<u>Material</u>
Base and frame	Cast iron, SAE G3500 or G4500, welded steel, SAE 950C, 945C
Crankshaft:	Forged steel, SAE 1046, 4140, or 4340
Connecting rods	Heat treated steel, SAE 4340 or 9840
Flywheel	Cast iron
Cylinders and cylinder heads	Cast iron, SAE G3000, G3500, or heads G4500 for cylinder heads
Pistons:	Cast aluminum, SAE 34, 39, 309, 314, 321, or 328
Exhaust manifold	Cast iron, SAE G3000 to G3500 or G4500

2.3 STARTING SYSTEM

- A. General: The starting system shall be of the electric, automatic starting type, complete with solenoid shift starter, batteries, battery rack, battery cover, cables, and constant voltage charger, capable of at least three 15-second starting attempts in a 30 degree F ambient temperature, without being recharged. Dry contacts shall be provided for remote indication of starting attempts. The engine-generating set shall contain a complete engine start-stop control which automatically starts the engine on closing contact and stops the engine on opening contact. Once started, the engine shall remain in operation for an adjustable period from 5 to 90 minutes if the engine control selector switch is in the test position or for an adjustable period determined by the automatic transfer switch if the engine control selector switch is in the automatic position. Cycle cranking shall be provided for three 15 second crank periods separated by 10 second rest periods. A cranking limiter shall be provided to open the starting circuit in approximately 30 to 90 seconds if the engine is not started within that time. Low oil pressure, high coolant temperature, overspeed, underspeed vibration or overcrank shall

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automatically shut down the engine. The engine control shall be automatically locked out upon emergency shutdown.

- B. Batteries: The engine-generator set shall be provided with a heavy duty, high rate of discharge, lead acid starting battery for diesel engine starting. The battery shall have sufficient capacity for a minimum of three 15 second crank periods each separated by a 10 second rest period, without recharging. Cold-cranking amperage capacity shall conform with the requirements of SAE Standard J-537 for zero degrees Fahrenheit and shall provide a minimum of 10 cold cranking amperes. Performance of the battery system shall comply with EGSA 100B. The battery voltage shall be compatible with that of the starting system.

The battery rack shall be mounted on the unit and located above the floor. A fiberglass enclosure shall be provided for the battery and rack. The battery shall be guaranteed for a minimum of 5 years. The batteries shall be mounted on the engine-generator skid. Batteries shall be furnished complete with interunit connectors and battery charger.

- C. Battery Rack: A two-step battery rack shall be provided by the battery manufacturer. The rack shall be constructed to suit the batteries furnished. Rack rails shall be insulated with plastic. Batteries shall be arranged so that all electrolyte levels are easily visible. It shall be treated to be resistant to deterioration by batter electrolyte. Construction shall be such that any spillage or boil over battery electrolyte shall be contained within the tray to prevent a direct path to ground.

- D. Battery Charger:

1. The battery charger shall be UL listed, float type, of the SCR full wave rectification design. The charger shall be dual rate output allowing for automatic initiation of high rate charging on battery demand. An AC outage shall not be the sole criteria for initiation of high rate charging, nor shall this charging be performed for a preset period of time. High rate charging shall be proportionate to battery demand only, and shall be controlled by solid state circuits monitoring battery demand.
2. The charger shall be capable of full output from 14 to 122 degrees F at the Project site.
3. The charger input shall be single phase, 120 VAC, 60 Hz. Output current/voltage shall be sufficient to recharge the battery in order to perform a repeat of the duty cycle in 12 hours. In addition, the charger shall supply continuously all required secondary loads.

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4. Battery charger shall meet the performance requirements of EGSA 100C, and shall include the characteristics required by NFPA-110 Para. 3-5.4.6. Output voltage regulation shall be $\pm 1.0\%$ when connected to the battery with input variations of +10% voltage and +5% frequency from zero to full rated output.
5. The battery charger enclosure shall be NEMA I rated in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods. Charger shall be installed with vibration isolators and wired on the generator set. Connections to the battery shall be solid wired (clip-on type clamps not acceptable).
6. Features shall include the following:
 - a. Automatic "float-to-equalize" operation, with individual potentiometer adjustments.
 - b. "Power on" lamp to indicate when charger is operating.
 - c. Reverse polarity protection.
 - d. DC output fuse protection.
 - e. Automatic current limiting protection.
 - f. Battery charger failure alarm contacts, set to close if AC power is lost to charger.
 - g. Low and high battery voltage alarm contacts, set to close if battery voltage drops below 90 percent or rises above 110 percent of rated.

2.4 COOLING SYSTEM

- A. General: A complete, engine-mounted radiator cooling system including radiator, motor-driven fan and circulating pump, bypass thermostats, interconnecting piping and appurtenances shall be provided for the engine. The system shall be designed to use a water and glycol solution with a freezing point below minus 15 degrees F. The radiator shall be designed for a maximum bottom tank temperature of 175 degrees F. A coolant circulating pump shall be provided with ample capacity to circulate the required flow of engine jacket water through the radiator to remove the heat rejected from the engine to the jacket water and to maintain the water temperature as recommended by the manufacturer.
- B. Radiator: The radiator shall be the high capacity copper splitcore, fin and tube type, adequately sized for 110% of full load at an ambient temperature of 110 degrees F, to properly cool water from the engine jackets, and lube oil cooler under the operating conditions indicated. The radiator shall have an air discharge adapter for connection to an air duct.
- C. Fans: Fans shall be of the multibladed belt-driven or direct-drive type complete with a shroud or protective guard. Fan blades shall be of adjustable pitch,

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airfoil design, selected for high efficiency and quiet operation. Fan tip speeds shall be held as low as practicable to reduce fan noise to a minimum.

- D. Pump Belts: Water circulation pump belts, if any, shall be T wedge type with QD sheaves, rated at 150% of running horsepower.
- E. Coolant Hose: Coolant hose shall be flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric. It shall be rated at 50 psig maximum working pressure with 180 degree F coolant, and noncollapsible under vacuum. End fittings shall be flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.5 EXHAUST SYSTEM

- A. General: The exhaust system shall be complete and shall include flexible connectors mounted directly on the generator manifold flange, condensate trap with drain plug or cock, roof thimble, and silencer. The exhaust system shall be provided with a means to prevent rain from entering the exhaust outlet. The exhaust system shall comply with NFPA 211. The flange rating shall be same for the emergency generator and the silencer.
- B. Pipe and Coupling: The engine exhaust coupling shall be stainless steel heavy duty, convoluted pressure hose-type. The flexible coupling shall have an overall length of not less than 16 inches and 150 lb ANSI steel flanges, and it shall be designed for 1250 degrees F service. All bolts, nuts, and clamps necessary for the installation of the flexible coupling and exhaust piping shall be provided. All parts of the exhaust system, except flanges, shall be of Type 316 stainless steel. Exhaust piping inside of buildings shall be Schedule 20 stainless steel, insulated with 4-inches of high temperature calcium silicate insulation in 2 layers, staggered, suitable for 1250 degrees, applied over 3/4-inch corrugated metal, and finished with aluminum plate aluminum flanges. The pipe shall be supported by steel saddles welded to the pipe and extending through the insulation.
- C. Silencer: The exhaust system shall be equipped with a Type 316 stainless steel hospital type flanged silencer which shall meet local and regional noise requirements, without exceeding the manufacturer's back-pressure limitations. Supports shall be provided for horizontal suspended installation that is independent from the generator set unit. The unit shall employ ported tubes in a single or multichamber, nonreactive design selected to achieve the degree of silencing indicated, with inspection ports and drain fittings in each chamber.
- D. Roof Thimble: A NFPA 37 and UL-103 compliant factory built ventilated roof thimble rated for 1250 degrees F shall be provided. The roof thimble shall

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include vent flashing and a storm collar. The thimble shall be Selkirk Metalbestos Model P-MVT or equal.

2.6 COMBUSTION-AIR-INTAKE SYSTEM

- A. Air-Intake Silencer: The air-intake silencer shall be filter type that provides filtration as recommended by engine manufacturer. The sound level emanating from air intake shall meet local and regional requirements. The air-intake silencer shall be factory installed on engine generator set at a location readily accessible for service.
- B. Intake Duct Connection: Size and connect intake duct to engine as recommended by manufacturer. The flexible connector shall be flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1. Select metal compatible with connected duct system. Use spring hangers and supports attached to building structure as specified in Section 15020 - Pipe Supports, for air-intake piping.

2.7 ENGINE JACKET WATER HEATER

- A. A jacket water heater shall be installed on each engine, complete with thermostat control in the engine cooling water system to maintain a jacket water temperature of 100 degrees F at all times, while the engine is not in operation. The heater shall be an electric immersion heater with waterproof enclosure, suitable for 1800 watts, 208 VAC, single-phase, 60 Hz power supply.
- B. Heater shall be mounted on the generator base rails and provided with flexible hoses to the engine. Flexible hoses shall be rated at 300 degrees F. and 150 PSI. Provision shall be made for isolation of the jacket water heater with valves installed at the engine side of the flexible hoses. Provide a disconnect safety switch, or disconnect plug, to isolate the heating element from the electrical source for maintenance purposes.

2.8 LUBRICATION SYSTEM

- A. General: The engine shall be of the wet sump type, provided with a full pressure lubricating oil system arranged to distribute oil to all moving parts of the engine. The lubricating oil pump shall be of the positive displacement type and shall be gear-driven from the engine crankshaft or camshaft. The pump shall have ample capacity to circulate the amount of lubricating and cooling oil required by the engine at all operating speeds. The lubricating system integral with the engine shall be complete with all required pipes, valves, heaters, fittings, pump, pressure gauge, filters and other necessary components to complete the system.
- B. Oil Filter: A full flow filter shall be provided. A built-in pressure relief bypass complete with pressure actuated valve and capable of conveying the

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maximum rate of oil flow shall be provided around each oil filter. The filter shall be rated to remove 90 percent of the particles 5 micrometers and smaller while passing full flow.

- C. Oil Cooler: The engine shall be equipped with a lubricating oil cooler, sized to cool the oil as recommended by the manufacturer. Aftercooler water shall be circulated through the water side of the oil cooler.
- D. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.

2.9 GOVERNOR

- A. The engine-generator set shall be equipped with an engine speed isochronous electronic governing system to provide speed regulation within plus or minus 0.25% of rated frequency under steady state load conditions. . Regulation shall be as defined by IEEE Std 126-1959/83. Governor performance shall comply with EGSA 100E. Provide overspeed shutdown wiring and signal light in the control panel. The governor shall be of the hydraulic type, with provision at the engine for manual adjustment of speed, speed droop and load limit.

2.10 ENGINE-MOUNTED PANEL

- A. General: The control panel shall be totally metal enclosed, assembled, wired, tested and shock mounted on the engine-generator set by the manufacturer. The control panel shall contain the 100% rated main circuit breaker, frequency meter, running time meter, voltage adjusting rheostat, AC voltmeter (dual range, indicating all voltages), voltmeter phase selector switch, AC ammeter (dual range, indicating current each phase), ammeter phase selector switch, battery charge rate ammeter, engine controls and instruments, pushbuttons, switches, relays, wiring, terminals, indicating lights and other required components.
- B. Gauges: A vibration-isolated engine panel, NEMA rated in accordance with the area designations of Section 16050 - Basic Electrical Materials and Methods, with the following gauges and meters shall be mounted on the engine, with the face of the panel being illuminated.
 - 1. Jacket water temperature gauge
 - 2. Oil temperature gauge
 - 3. Lubricating oil pressure gauge
 - 4. Intake manifold temperature gauges
 - 5. Digital tachometer
 - 6. Operating hour meter
 - 7. Exhaust temperature gauge

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- C. Local and Remote Signals: Local and remote alarm controls and engine protection with signal lights and audible alarm shall be provided for the following alarms:

1. Overcrank-lockout
2. Low oil pressure – shutdown
3. Overspeed - shutdown
4. High water temperature – shutdown
5. Low water level – shutdown
6. Low oil level
7. Low fuel - alarm
8. Control switch not in remote position
9. Circuit breaker in off position
10. Emergency stop depressed
11. High coolant temperature – preliminary alarm
12. Low oil pressure – preliminary alarm
13. Low voltage in battery
14. Battery charger malfunction
15. High battery voltage

The alarm lights shall remain on until the alarm condition is corrected and an alarm reset switch is activated. Indicating lights shall be the same voltage as the starting battery and shall be provided complete with color caps. The lamps shall be removable without entering the generating panel.

- D. Switches: The engine shall be provided with the following devices, factory installed and adjusted. Each device shall be suitable for use with the engine's 24 VDC control power and shall be complete with all necessary conduit and wiring. Phase selector switches shall be panel type, heavy duty, non-illuminated equipped with a standard black knob. Leads shall be brought to a common engine-mounted control terminal panel located on the subbase. Protective devices shall include the following:

1. An overspeed switch shall be separate from the governor and shall open at 10% above synchronous speed to actuate an alarm contact.
2. A low oil pressure switch which opens when the pressure in the lube oil system is below the permissible operating pressure.
3. A temperature switch, mounted in the lubricating oil system, designed to open when the oil temperature downstream from the oil cooler reaches unacceptable levels.
4. Cooling water float switches located in the radiator. The float switches shall cause the engine-generator to shut down and alarm if the coolant level in the radiator drops below acceptable limits.

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5. A switch to silence the audible alarm.
 6. A lamp test switch for local and remote signals.
 7. An ammeter switch with four positions (off-A-B-C). Ammeter switch shall have intermediate positions such that current transformer circuits are never open circuited.
 8. A voltmeter switch with four positions (off-AB-BC-CA).
- E. Design: All devices shall be specifically designed for engine service of a type suitable for reliable operation in the presence of continuous vibration. All wiring, conduit, and appurtenances shall be as indicated under Division 16. Conduits shall be routed to provide maximum access to all maintenance points, devices and appurtenances.
- F. Instrument Taps: The engine shall be provided with suitable taps or connections available for the measurement of the following:
1. Lubricating oil inlet pressure
 2. Engine speed
 3. Jacket water inlet temperature
 4. Aftercooler water inlet temperature
- G. Operation: The panel shall include automatic start/stop operation. The engine control shall be automatically locked out upon safety shutdown. Manual controls shall be provided on the front of the panel to permit manual startup and shutdown of the engine. The safety shutdown of the engine shall initiate an alarm signal for remote annunciation. The following devices shall be provided on the face of the panel:
1. MANUAL-OFF-REMOTE selector switch
 2. EMERGENCY STOP red pushbutton with guard
 3. ALARM ACKNOWLEDGE/CANCEL pushbuttons
 4. LOCKOUT RESET pushbutton

When the mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic-transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

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- H. Circuit Breaker: The main emergency power circuit breaker shall be enclosed, molded case, thermal-magnetic, trip-free manual, quick-make, quick-break, 600A three poles with solid-state trip for long time, short time, and ground fault sensors].
- I. Nameplates: Provide all the required nameplates. The nameplates shall have inscriptions that identify the equipment and all its positions.
 - 1. The nameplates shall be engraved, laminated black plastic with minimum ¼-inch high letters showing through from the white core, NEMA ES-1, 3-ply (Black-White-Black), 1/16-inch thick, beveled and satin finished. Nameplate inscriptions shall include the identification for the equipment and loads and shall identify the controls on control equipment.
 - 2. Nameplates shall be attached to the object, or adjacent to the object, with self taping stainless steel screws. Adhesive materials shall not be used for attachment.

2.11 FUEL SYSTEM

- A. The engine shall be equipped with a fuel system suitable for operation on DF-2 diesel fuel with a sulfur content not to exceed 0.05 percent by weight. Fuel system shall include an engine driven transfer pump, replaceable filter, fuel purifier, and flexible fuel lines. Fuel system shall comply with the requirements of NFPA-37 and NFPA-110 Paragraph 5-9.
- B. Fuel Storage System:
 - 1. The generator set shall be equipped with its own sub base double wall fuel storage tank with a fuel tank capacity sufficient for 24 hours of continuous operation for the 200 KW Eng./Gen. The fuel tank shall be UL listed and be constructed of aluminized steel channel and end plates - 7 Ga. Tank top and bottom 10 Ga. Tank shall not extend within 12 inches of the generator end to provide access for electrical conduit from below, tank shall be built and labeled in accordance with UL-142. Mounting feet shall provide 1 inch clearance between bottom of tank and foundation.
 - 2. Provide necessary suction and return line connections at pipe openings provided.
 - 3. Fuel piping between tank and engine shall be type K soft temper copper tubing with flared fittings.

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4. Provide low fuel alarm set at 4 hours of remaining fuel, and a rupture basin alarm should the primary fuel containment tank rupture. Provide 5 gallon fuel spill containment.
5. Storage tank shall be provided with 1-1/4" NPT vent 2" NPT fill, 2" level gauge, 1/2" dip tubes for fuel supply and return and 2" NPT for control sensor. Twelve feet above ground normal vent extension.
6. Provide weatherproof basin and double wall cover. Power Armor Plus type textured epoxy-based rubberized coating.
7. Provide NFPA 704 identification decal.
8. Tank and containment basin shall be braced for seismic restraint. The tank shall be anchored directly to the concrete foundation by means of approved anchor bolts. A minimum of four (8-12) anchors shall be provided by the generator set supplier. Provide calculations signed by an engineer registered in the State of California verifying compliance with California Administrative Code Title 24 for Zone 4. These calculations shall be a part of the submittal data provided.

2.12 FLEXIBLE METAL HOSE

- A. Flexible metal hose connectors for jacket water, lube oil, fuel and exhaust piping shall be provided. Water, oil and fuel connectors shall be single braided, Type 316 stainless steel, 150 psig working pressure. Fuel connectors shall bear the Underwriters' Laboratories label and shall be rated for 300°F and 100 psi. The exhaust connector shall be as indicated above. All connectors shall be selected for a design of not less than 10 million full displacement cycles. Flexible connectors shall be not less than 12 inches long and installed with no visible deflection.

2.13 GENERATOR SET MOUNTINGS

- A. The engine-generator set shall be equipped with vibration isolators and shall be capable of withstanding earthquake forces of seismic zone 4 in accordance with the California Building Code, latest edition. The generator set shall be mounted on a welded structural steel base, with cross-framing for additional stiffening. The entire welded steel base shall be installed with steel spring isolators. The steel spring isolators shall meet the following requirements:
 1. The minimum steel spring static deflection shall be 0.375-inches.
 2. The ratio of horizontal spring constant to vertical spring constant shall be at least 1:1.
 3. The spring diameter shall be no less than 0.8 times the compressed spring height at rated load.

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4. The difference between compressed spring height and solid spring height shall be at least 0.5 times the rated static deflection.
5. The spring isolator shall include an adjusting bolt for leveling and attachment to the mounting base and shall be mounted on ¼-inch thick ribbed or waffle-pattern neoprene acoustical pad.
6. The spring isolator shall be contained within a rigid housing that includes vertical stabilizers and seismic restraints.
7. The spring isolators shall be selected for uniform static deflections according to the weight distribution of the electric generating plant, disturbing forces such as fan thrust during starting, and seismic Zone 4 restraints.
8. Submittals shall include spring diameters, static deflections, compressed spring height, and solid spring height.]
9. The CONTRACTOR shall submit certification of torsional vibration compatibility in compliance with NFPA 110.

2.14 GENERATOR

- A. General: The generator shall be of the brushless, revolving field, heavy-duty industrial type, rated 200 kW continuous when burning diesel fuel, 0.8 power factor lagging, 250 KVA, 3-phase, 4-wire, 227/480 V, 130 degrees C rise, 60-Hz, 1800 rpm, Class F insulation with field windings braced for solid grounding. Full load current capacity shall be 300 amps. Each generator shall be suitable for operation the elevation and expected maximum ambient temperature at the project site. The CONTRACTOR shall provide a larger engine-generator if required to start and run the load indicated. Some loads are variable frequency drives, which generate some undesirable harmonics. The generator shall accept a single block application of full rated load with voltage and frequency recovery to normal value within two seconds. The voltage dip shall not exceed 20% nor shall the speed regulation exceed 2% following block load application. In addition, when the starting load (motor) is applied, the voltage dip shall not exceed 20% at any point of the motor starting sequence. The generator excitation system shall consist of a three phase alternating current exciter, the output of which is directly connected to the main generator field through silicon rectifiers, and shall not have commutator or brushes incorporated in the generator design. The generator shall be a single-bearing machine conforming to applicable NEMA standards and shall have a rigid drip-proof frame with covers to provide easy access to the interior. The generator shall be supplied with a solid state voltage regulator or equal mounted on the machine which will hold the voltage to the set value with not over 2% variation from no-load to full-load. The rotor shall be directly connected to the engine through a semiflexible driving flange to insure permanent alignment. The generator shall be mounted on a heavy, structural, common base with the engine, and shall be equipped with the required supports and hardware.
 1. Performance. Start time shall comply with NFPA 110, Type 10, system requirements. The frequency regulation shall not exceed

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plus or minus 0.25% of its mean value for constant loads from no load to full load. Frequency regulation under varying loads shall be isochronous. Voltage regulation shall not exceed plus or minus 2% of its mean value for varying loads and plus or minus 1% of its mean value for constant loads from no load to full load. The transient voltage dip shall be less than 20% of rated voltage when full nameplate rated load and rated power factor is applied to the generator. Recovery to stable operation shall occur within 4 seconds. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus 1% of the rated voltage. A rheostat shall provide a minimum of plus or minus 5% voltage adjustment from the rated voltage. Temperature rise shall be within the NEMA MG1-22.40 standard. The telephone influence factor, determined according to NEMA MG1, shall not exceed 50.

B. Materials:

<u>Component</u>	<u>Material</u>
Stators	
Frame	Bar and ring steel
Laminations	Electrical grade sheet steel
Windings	Copper
Rotors	
Laminations	Electrical grade sheet steel
Windings	Copper

2.15 GENERATOR CONTROLLER

- A. A solid State Controller shall be vibration isolated above the generator. The microprocessor control board shall be moisture proof and capable of operation from -40c to 85c. Relays will only be acceptable in high current circuits. Generator set instrumentation, control and auxiliary equipment shall meet the performance standards of EGSA 100G.
- B. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:
1. Fused DC circuits.
 2. Complete two-wire start/stop control which shall operate on closure of a remote contact.

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3. Speed sensing and a second independent starter motor disengagement systems shall protect against the starter engaging with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
5. Cranking cyler with 15-second ON and OFF cranking periods.
6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
7. Engine cool down timer factory set at five minutes to permit unloaded running of the standby set after transfer of the load to normal.
8. Three-position (Automatic - OFF - TEST) selector switch. In the test position, the engine shall start and run regardless of the position of the remote starting contacts. In the automatic position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open. In the off position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault lamp shall also be accomplished by putting the switch to the off position.

2.16 GENERATOR SET ACOUSTICAL ENCLOSURES

- A. Provide weatherproof sound alternating enclosures. Enclosure and exhaust system shall be sound attenuated to limit noise level to 75 dbA at 23 feet.
- B. Enclosures shall be equipped with removable side panels allowing access to engine and control panels. The side panels shall have provisions for padlocking.
- C. Provide an exhaust opening, rain shield and battery rack inside the enclosure.
- D. Provide louvers on either end of the enclosure for proper ventilation of generator set. Louvers must be sized properly, so there is no need to remove side panels for cooling.
- E. Enclosure shall be constructed of minimum 18 gauge steel panels, painted inside and out with rust inhibiting ASA gray primer and two coats of high gloss, weather-proof, sag-resistant vinylac in the manufacturer's standard

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color through an electrical bonding process. exterior paint. Exterior finish color shall be determined by RESIDENT ENGINEER. One gallon of exterior paint shall be included for field touchup.

Door shall have common keyed latch. Provide two (2) sets of keys.

2.17 TRAILER FEATURES

- A. A trailer shall be provided with the gen set with the following features:
1. 2 5/16 in. ball hitch coupler with adaptability for an optional Lunette eye.
 2. Lockable utility tool box.
 3. Running lights with 7-wire harness and connector.
 4. Two axle trailer with electric brake system including breakaway and battery backup. Axles sufficient to carry weight of operational generator unit. DOT approved.
 5. Rear stabilizer trailer jacks.
 6. Spare tire

2.18 MISCELLANEOUS COMPONENTS

- A. Components that are required to satisfactorily complete the generating system shall be provided by the CONTRACTOR even if not described in this Section.

2.19 NAMEPLATES, TOOLS AND SPARE PARTS

- A. Spare Parts: The Work includes the following spare parts for each engine-generator unit
- | Quantity | Description |
|----------|--|
| 1 | Lube Oil Filter Element Double Length |
| 1 | Lube Oil Filter Cover O-Ring |
| 1 | Water Pump Belt Set |
| 1 | Aux. Water Pump Belt Set |
| 2 | Air Cleaner Element |
| 16 | Spark Plug |
| 1 | Each size and type of relay |
| 1 | Each size and type of lamp in the control panels |
| 2 | Complete replacements, engine oil filters |
| 2 | Complete replacements, air inlet filters |
| 1 | Complete set special maintenance tools |

Spare parts shall be crated, packaged, and stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the boxes.

2.20 ACCESSORIES

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- A. Accessories. All accessories including hardware needed for the complete installation and proper operation of the electric generating plant shall be provided. An automatic transfer switch shall be provided in the main switchboard.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The engine-generator set shall be shipped, unloaded, installed and aligned in accordance with the procedure submitted with the shop drawings and per manufacturer's written recommendation and with NFPA 110. All fuel, coolant, exhaust piping and electrical conduit shall have flexible connectors so that vibration is not transmitted along these lines.

3.2 FIELD TESTING

- A. General: Coordinate all startup and testing activities with the RESIDENT ENGINEER. The equipment shall be subject to the following tests, including a final acceptance test to assure compliance with all operation requirements indicated. Verify all equipment and auxiliary devices are installed properly and are operating properly. Check all fluid levels and check for leaks or vibration. The field test shall include all tests performed in the factory prototype test plus an operational test that simulates a normal power failure and demonstrates that the emergency generator set can start and run all emergency loads. In addition, perform all tests required by NFPA 110. Test results shall show the maximum voltage dip that occurs during the emergency starting sequence. The field test shall be conducted by the CONTRACTOR in the presence of the RESIDENT ENGINEER. All costs of testing, including fuel, shall be borne by the CONTRACTOR. Upon completion of the tests, the CONTRACTOR shall refill the fuel tank. The test procedure shall be developed by the CONTRACTOR and shall, as a minimum, include the following features:
 - 1. Static tests of all control and protective circuits.
 - 2. Not less than five cold starts.
 - 3. Not less than 4 hours of transient response tests using loads applied by portable load bank.
 - 4. Not less than 8 hours of continuous operation at full load.
 - 5. The CONTRACTOR shall submit four copies of the certified field test reports in typed form to the RESIDENT ENGINEER.
- B. A complete system reactive load bank test is required after all equipment is installed.
- C. Portable Load Bank: The CONTRACTOR shall furnish a portable load bank to provide sufficient load to complete the required testing.

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- D. Coordinate tests with tests for transfer switches and run them concurrently.
- E. A sound test shall be made at 6 feet from nearest property line to determine if the sound enclosure meets the City's noise ordinance requirements stated in City Municipal Code Section 59.5.0401. If the enclosure does not attenuate the generator noise to meet the noise ordinance requirements the manufacturer shall provide solutions to meet the ordinance requirements.
- F. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- G. Initial fuel fill and fuel for testing shall be provided by the supplier of the engine generator. After satisfactory run test on site tank shall be refilled to 90% full.

3.3 CLEANING

- A. On completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

**** END OF SECTION ****

SECTION 16290 - POWER MONITORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The MCC manufacturer shall install power monitors, current transformers, and potential transformers, all in accordance with the intent and requirements of the CONTRACT DOCUMENTS.
- B. Nameplates shall be furnished as specified in Section 16050.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 09800 Protective Coating
 - 3. Section 13300 Instrumentation and Control
 - 4. Section 16050 Basic Electrical Materials and Methods
 - 5. Section 16950 Electrical Tests

1.3 REFERENCE CODES AND STANDARDS

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.
 - 1. Codes and Standards:

NEC	National Electrical Code
NESC	National Electrical Safety Code (ANSI C2)
UL	Underwriters Laboratories
CBEMA	Computer Business Equipment Manufacturers Association
 - 2. Industry Standards

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ANSI C12.20	Electricity Meters 0.2 and 0.5 Accuracy Classes
ANSI C2	National Electrical Safety Code
ANSI C.62.41	IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
FCC Part 15	
Subpart B, Class A	Electromagnetic Emission Standards
IEC60687 0.2S	Standards for Metering Accuracy
IEC1000	Electromagnetic Compatibility Limitations on Voltage Fluctuations
ENV51040	IEC Standard for Radiated EM Field Immunity
ENV51041	IEC Standard for Conducted EM Field Immunity
EN50081-2	IEC Standard for Electromagnetic Compatibility, Emissions
EN50082-2	IEC Standard for Electromagnetic Compatibility, Immunity
EN55011 (CISPR 11)	IEC Standard for Radiated/Conducted Emissions
EN55022 (CISPR 22)	IEC Standard for Radiated/Conducted Emissions
IEEE C.37.90.1	Standard for Surge Withstand Capacity for Protective Relays and Relay Systems
UL 3111-1	Electrical Measuring, Testing and Signal Generation Equipment

1.4 SYSTEM DESCRIPTION

- A. The power monitors shall be mounted as indicated on the CONTRACT DOCUMENTS, in the control section of the appropriate breaker cubicle.

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- B. Appropriate potential transformers and current transformers shall be furnished to provide sensing signals for the power monitors.
- C. Installation of power monitors, ancillary equipment, and wiring connections to all electrical circuits, and terminal strips for external devices shall conform to all local and national electrical codes.
- D. Shorting switches or test blocks shall be required for all metering CT inputs.

1.5 SUBMITTALS

- A. The power monitor supplier shall provide technical data sheets, installation manuals and/or user documentation manuals that describe the product installation and operation, physical data, electrical characteristics and connection requirements of the power monitor.

1.6 QUALITY ASSURANCE

- A. The power monitor supplier's quality assurance process shall be certified by an independent certification agency to meet ISO 9001 quality assurance standards.
- B. The final MCC lineup incorporating the power monitors must be UL certified and labeled by the assembler.
- C. The power monitors shall be calibrated at the factory using an instrument that is certified to have been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST).

1.7 SITE CONDITIONS

- A. The power monitors shall be capable of operating under the following environmental conditions:
 - 1. Temperature: 40 degrees F to 95 degrees F
 - 2. Humidity: 5 percent to 95 percent non-condensing

1.8 WARRANTY

- A. The power monitors shall be warranted by the manufacturer against manufacturing defects for a period of three (3) years including parts and labor.
- B. Warranty service may be performed by the manufacturer or authorized representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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- A. The power monitors shall be manufactured by Eaton Power Expert, or equal, with the following options:
1. Ten megabyte (MB) memory upgrade
 2. The 10Base-FL Ethernet port and TCP/IP protocol with all associated drivers and supporting hardware.
 3. Analog auxiliary card which accepts (4) 0-20mA inputs and delivers (4) 0-20mA (scalable to 4 to 20mA) outputs
 4. Current transformers rated 10 amperes each for all monitored phases.

2.2 POWER MONITORS

- A. The power monitor shall be a multi-function 3 phase solid state unit with ability to connect to either 3 phase, 4 wire wye or 3 phase, 3 wire delta circuits.
- B. Capabilities for voltage and current inputs to the meter shall conform to the following at a minimum:
1. The power monitor shall accept input of four (4) independent voltage inputs and five (5) independent current inputs of the stated capacity.
 2. Voltage input shall be 120 volts AC with available option for direct connection to voltage circuits of up to 600 VAC without the use of potential transformers.
 3. Voltage input shall have an overload capacity of 1500VAC RMS continuous and a dielectric withstand capability of 2500 volts AC, 60Hz for one minute.
 4. Current input shall be rated for 5 amps with a continuous input capability of 20 amps.
 5. Current inputs shall be Class 10, rated for a 1-second over-current rating of 500 amps, non-recurring, and 20 amps continuous.
- C. The power monitor shall measure and report the following quantities at a minimum:
1. Voltage, intervals must be available simultaneously both phase to neutral and phase to phase, for all three phases; Auxiliary voltage; Phase angles for each voltage relative to each other.
 2. Current, phase A, B, C, N-measured, and N-calculated; Phase angles for each current relative to voltages.

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3. Watts (total and per phase), VARs (total and per phase), VA (total and per phase), Power Factor (total and per phase) and Frequency.
 4. Accumulated Watt-hr, VA-hr, and VAR-hr; Watt-hr received; Watt-hr delivered.
 5. Updates of all voltage and current readings at intervals of 1/2 cycle and 1 second. Readings shall be available for both metering and control. All specified readings shall be made available via the RS-485 ports.
 6. Time-stamped maximum and minimum readings for every measured parameter
 7. Coincident VAR readings for all maximum Watt readings
- D. Power monitor shall provide the following accuracies:
1. Voltage accuracy shall be within less than 0.1 percent for the 1 second readings.
 2. Current accuracy shall be within less than 0.1 percent for the 1 second readings.
 3. Power and energy accuracy shall be class 0.2.
 4. Frequency accuracy shall be within +/- 0.005 Hz or better.
- E. Power demand shall be able to be calculated using either of two (2) methods: Thermal Demand or Sliding Window Demand (Rolling Block).
- F. Power monitor shall provide multiple digital communication ports and support multiple open protocols.
1. Meter shall include four (4) independent, digital communications ports. Each port shall be RS-485 architecture. Port 1 shall be user selectable as either RS-232 or RS-485 architecture.
 2. Each port shall be user configurable with regard to speed, protocol, address, and other communications parameters. Ports shall support a maximum communication speed of 115k baud simultaneously.
 3. One communications port shall be configurable as either a master or a slave port. The master configuration shall enable the unit to act as an RTU and interface with other Modbus devices.
 4. Meter shall have an Ethernet RJ45 (10BaseT) port and an Ethernet Fiber (10BaseFL) port. All instantaneous data, logged data, event

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data, power quality analysis and waveform information shall be available using these open protocols.

- G. Power monitor shall provide sequence of events capture and recording.
- H. Power monitor shall be capable of time synchronizing to GPS time signal.
- I. Power monitor shall provide an external display to accommodate access to readings locally and/or remotely.
- J. Power monitor shall be equipped with a minimum of 10 MB of non-volatile RAM.
 - 1. Meter shall store historical trending data, power quality data, and waveform recordings in memory.
 - 2. In the event of loss of control power, data stored in memory shall be retained
 - 3. Memory shall be allocated to the various logging functions required. All logging features required shall be simultaneously available at the specified levels. Exercising any one feature at the specified level shall not limit exercising of any or all other features to their full, specified level.
 - 4. Meter shall store all programming and set-up parameters in non-volatile memory. In the event of loss of control power, meter programming data stored in memory shall be retained.
- K. Power monitor shall provide historical data logging for trending of measured values.
 - 1. The historical log shall be user configurable. User may select measured quantities and reading intervals for each log.
 - 2. The historical log shall record data where 10 readings are being stored every 15 minutes.
- L. Power monitor shall provide extensive power quality monitoring capability.
 - 1. Power monitor shall measure and record the magnitude and phase angle harmonics for all voltages and currents. Meter shall provide percent THD and K-Factor for all channels.
 - 2. All harmonic values shall be available through the digital communications ports.
 - 3. Power monitor shall capture and record all CBEMA quality events.

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4. Entries to the Limits log shall be time stamped to the millisecond and include the measured quantity value and label.
- M. Power monitor shall provide waveform recording to capture and record transients and quality problems on current and voltage waveforms.
1. Meter shall hold over 60 records of waveform recording in non-volatile memory. Each record shall be a minimum of 8 cycles duration at the highest sample rate or 64 cycles duration at the lowest sample rate.
- N. The power monitor shall provide the following functionality:
1. Arithmetic (+, -, X, /)
 2. Trigonometric functions: COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10
 3. Comparison and Logic functions: =, =>, <=, <>, <, >, AND, OR, NOT, IF
- O. The power monitor shall support direct display of all parameters on the front panel in user programmable groups, using plain language labels. Simultaneous access to all parameters shall be available through any communication port.
- P. The power monitor shall be field programmable as follows:
1. Basic parameters: Voltage input scale, voltage mode (wye, delta, single phase), current input scale, auxiliary input and output scales, and communications setup parameters are programmable. All basic parameters plus additional setpoint/relay and data log setup parameters shall be programmed via the communications port using a portable or remotely located computer terminal.
 2. The power monitor shall support customized configurations of all operating parameters.
 3. Provisions shall be made to ensure that programming through a computer can be secured by user ID and password.
 4. Provisions shall be made to ensure that programming through the front panel is secured by password.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All power supply and communications wiring connections shall be performed in accordance with the guidelines set out in the product documentation.

SECTION 16290 - POWER MONITORS

- B. All current and voltage sensing connections to the power monitor shall be made using appropriately rated CT shorting blocks and PTs.

3.2 FIELD QUALITY CONTROL

- A. The power monitor supplier shall offer field services to provide quality control with on-site personnel for installation, training, and start-up, as included in the project bid.

3.3 ADJUSTING

- A. The power monitor supplier shall offer field services to assist on-site personnel with re-configuration of the factory default for site-specific requirements.

3.4 DEMONSTRATION AND TRAINING

- A. The power monitor supplier shall offer field demonstration services to on-site personnel which include the following:
 - 1. A review of the power monitor operation and maintenance manual shall be provided by a qualified manufacturer's representative.
 - 2. A hands-on demonstration of the as-installed power monitor shall be performed.

**** END OF SECTION ****

SECTION 16400 – LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all electrical service sections, distribution switchboards, special control panels, control and terminal cabinets, control devices, circuit breakers, and all appurtenant work, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 09800 Protective Coating
3. Section 16480 Motor Control Centers
4. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electrical Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code or ordinance shall take precedence.

B. Codes:

1. NEC National Electrical Code

C. Commercial Standards:

1. ANSI/IEEE C37.20 Switchgear Assemblies, including Metal-Enclosed Bus
2. ANSI/NEMA ICS-2 Devices, Controllers, and Assemblies for Industrial Control
3. ANSI/UL 1008 Automatic Transfer Switches, Safety Standard for
4. IEEE Institute of Electrical and Electronic Engineers

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- | | | |
|----|------|--|
| 5. | NFPA | National Fire Protection Association |
| 6. | UL | Underwriters' Laboratories, Inc. |
| 7. | UL | National Electrical Manufacturer's Association |

1.3 OPERATION AND MAINTENANCE

- C. The CONTRACTOR shall submit operation and maintenance information in accordance with Section 01730 - Operations and Maintenance Information. The submittal shall be supplemented by written text and shall include the following:
1. Operating procedures.
 2. Maintenance procedures.
 3. Manufacturers parts list, illustrations, assemblies, and diagrams.

1.4 CONTRACT SUBMITTALS

- C. The CONTRACTOR shall submit shop Drawings of the service section and switchboards in accordance with Section 01300 - Submittals.
- D. After review by the RESIDENT ENGINEER, the shop Drawings of the service section shall be submitted to the utility company for approval before fabrication.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Materials:** All materials and equipment furnished under this Section shall be new; they shall be in accordance with the requirements of the Institute of Electrical and Electronic Engineers, the National Electrical Manufacturer's Association, the National Fire Protection Association, and the National Electrical Code. Where available, all materials and equipment shall bear the Underwriters' Laboratories label.
- B. **Equipment:** All equipment for the same purpose shall be of the same make.
- C. **Enclosure Requirements:** All outdoor equipment, fixtures, and wiring devices shall be of approved, weatherproof construction.
- D. **Standard Products:** Materials and equipment submitted for approval shall be the cataloged products of companies regularly engaged in the manufacture of such items, of the latest standard design that conforms to the specification

SECTION 16400 – LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

requirements, and shall essentially duplicate material and equipment that has been in satisfactory use for several years.

2.2 SWITCHBOARD

- A. Outdoor Construction: Outdoor construction shall be of the universal frame type using die-formed welded and bolted members. Enclosing panels shall be 14-gage steel, bolted in place. Installation shall be rodent- and bird-proof. An insulating compound shall be applied to the interior surface of the roof panels for condensation control. In addition, outdoor construction shall conform to the following:
1. Switchboard shall be totally enclosed, NEMA 3R.
 2. Bus bar shall be copper fully insulated. Copper shall be silver plated at joints. Bus bars shall be braced for short circuits of 42,000 A minimum, or more if so indicated. A full length copper ground bus bar shall be provided at the bottom of the switchboard enclosure.
- B. Floor-Standing Switchboards: Floor-standing distribution switchboards, and main service switchboard, shall be cataloged products of the main circuit breaker manufacturer. Switchboard shall be shipped fully assembled and tested.

2.3 MAIN SERVICE SWITCHBOARD

- A. General: The main service switchboard shall consist of a free-standing assembly which complies with the Contract Documents, with particular reference to the provisions of the above paragraph entitled, "Switchboard." The main switchboard shall be UL listed as suitable for utility type service entrance, 480 V, 3-phase, 4 wire.
- B. Switchboard: Switchboards shall be front accessible. Switchboards shall be constructed to accommodate additional distribution sections. The switchboards shall consist of the sections described in the following paragraphs.
- C. Service Section: The service section shall consist of an underground pull compartment and a revenue metering compartment all to utility requirements. Components such as meter bases, busses, lugs, auxiliaries, shall be provided.
- D. Main Circuit Breaker Compartment:
1. The main circuit breaker compartment's circuit breaker unit shall have the ratings indicated. Service neutral shall be brought to a terminal in the main circuit breaker compartment. A disconnecting

SECTION 16400 – LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

link shall be provided in a bus bar connection between the neutral terminal and the switchboard ground bus.

2. The circuit breaker shall have protective features with capability of selective tripping which can be used to provide overcurrent protection from overloads, short circuits, and ground faults.
- E. The circuit breaker shall be individually mounted stationary of the size and type indicated.
 - F. Manufacturer: The main switchboard shall be manufactured by Cutler-Hammer Pow-R-Line C, General Electric AV-Line or equal by Square D, Siemens or equal.

2.4 SWITCHBOARD INSTRUMENTS

- A. Indicating Meters: Indicating meters shall be of the following type and manufacture, or equal:
 1. Main Incoming Circuit Breaker:
 - a. Cutler Hammer IQ Data Plus II.
 - b. Multilin MTM Plus.
- B. Requirements: The instrument transformer shall comply with ANSI/IEEE C37.20-Switchgear Assemblies Including Metal-Enclosed Bus and shall have standard accuracy for relaying with the burdens imposed. Mechanical and thermal ratings of current transformers shall be coordinated with short circuit ratings of related circuit breakers. Potential transformers shall be mounted on a disconnecting rack and shall have primary fuse protection.
- C. Relays: The protective relays shall be mounted within draw-out cases; current measuring circuits shall be fitted with jacks to short circuit current transformers when relays are withdrawn. The relays shall have means for testing measuring circuitry with the relay in place. The relays shall be solid state type and the product of the switchboard manufacturer.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers with a Frame Size of 225 to 600 A: Circuit breakers with a frame size of 225 to 600 A shall be molded case with interchangeable thermal and adjustable magnetic trip elements. Ground fault protection shall be provided by means of a core balance transformer encircling all feeder leads. The transformer shall energize a surface-mounted, solid-state relay, adjustable from 10 to 20 percent of phase current with an adjustable time delay of zero to 36 cycles. Ground fault protection shall include a test panel containing indication and test tripping circuits.

SECTION 16400 – LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

PART 3 -- EXECUTION

3.1 INSTALLATION - GENERAL

- A. General: All electrical equipment shall be installed securely in place. Equipment shall be mounted parallel and perpendicular to the walls, floors, and ceilings.
- B. Anchors: All anchors and fasteners shall be types designed for the intended purpose and shall be capable of adequately, safely, and permanently securing the material in place. Generally, screws shall be used on wood surfaces, masonry anchors in concrete or brick, toggle bolts on hollow walls, machine screws, bolts, or welded studs on steel. Nails shall be used only for temporary attachment or support.
- C. Omissions or Conflicts: Omissions or conflicts on the Drawings or between Drawings and Specifications shall be brought to the attention of the RESIDENT ENGINEER for clarification before proceeding with the work.
- D. Preparation: The CONTRACTOR shall make all necessary provisions throughout the site to receive all equipment as construction progresses and shall furnish and install adequate backing, supports, inserts, and anchor bolts for the hanging and support of all electrical cabinets, enclosures, conduits, panelboards, and switches, and shall furnish and install sleeves through walls, floors, or foundations where electrical lines are required to penetrate.
- E. Leveling: Floor-standing equipment shall be leveled with shims as required to maintain horizontal surfaces within 1/32 inch per horizontal foot; after leveling, equipment shall be anchored, then grouted so that no space exists between concrete and equipment support beams.

3.2 PREPARATION AND FINISH SYSTEMS

- A. Equipment cabinets and enclosures furnished under this Section shall have a finish that conforms to Section 16480 - Motor Control Centers.

**** END OF SECTION ****

SECTION 16412 – AUTOMATIC TRANSFER SWITCHES

PART 1 -- GENERAL

1.1 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. ANSI C 62.1 Surge Arrestors for AC Power Circuits
2. NEMA ICS 1 Genera Standards for Industrial Control Systems
3. NEMA ICS 2 Industrial Control and Systems Controllers, Contactors, and Overload Relays not more than 2000 volts ac or 750 volts ac
4. NEMA ICS 6 Industrial Control And Systems: Enclosures 250, Enclosures for Electrical Equipment (1,000 Volts Maximum)
5. NFPA 70 National Electrical Code
6. UL Underwriters Laboratories, Inc.

1.2 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 13300 Instrumentation and Control
3. Section 16040 Electric Motors
4. Section 16950 Electrical Tests

1.3 CONTRACTOR SUBMITTALS

A. Action Submittals:

1. Descriptive product information.
2. Dimensional drawings.
3. Control diagrams.

SECTION 16412 – AUTOMATIC TRANSFER SWITCHES

4. Conduit entrance locations.
5. Equipment ratings.

1.4 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

- A. Transfer switch to be provided by the low voltage motor control center manufacturer.

2.2 GENERAL

- A. Transfer switch to be product of a single manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
- B. In accordance with applicable standards of NFPA 70, NEMA ICS 1, NEMA ICS 2, NEMA ICS 6, IEEE C37.90.1, and UL 1008.
- C. Transfer switch consisting of inherently double-throw power switch unit with interconnected control module.
- D. Rated 100 percent, in amperes, for total system transfer of motor, electric heating, discharge lamp loads, and tungsten-filament lamp loads.
- E. Switches rated 400 amperes and below suitable for 100 percent tungsten-filament lamp loads.
- F. Main and arcing contacts visible for inspection with cabinet door and barrier covers removed.

SECTION 16412 – AUTOMATIC TRANSFER SWITCHES

- G. Neutral transfer contacts for switched.
- H. Suitable for 480 volts, three-phase, three-wire electrical service having an available short circuit current at line terminals of 65,000 amperes rms symmetrical.
- I. Switch Rating: 400 continuous amperes in non-ventilated enclosure.
- J. Current carrying capacity of arcing contacts shall not be used to determine the transfer switch rating.
- K. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- L. Operating Conditions:
 - 1. Ambient Temperature: Maximum 40 degrees C.
 - 2. Equipment to be fully rated without any derating for operating conditions listed above.

2.3 ENCLOSURE

AA.Type: Open for mounting in motor control center.

2.4 TRANSFER SWITCH

- A. Type: Electrically operated, mechanically held, double-throw.
- B. Momentarily energized, single-electrically operated mechanism energized from source to which load is to be transferred.
- C. Locking mechanism to maintain constant contact pressure.
- D. Mechanical interlock switch to ensure only one of two possible switch.
- E. Silver alloy contacts protected by arcing contacts.
- F. Main and arcing contacts visible when door is open and barrier covers removed.
- G. Manual operating handle for transfer in either direction under either loaded or unloaded conditions.
- H. Internal control wire connections made with ring or spade type terminals, lock washers, and sleeve type marking labels.

2.5 CONTROL MODULE

SECTION 16412 – AUTOMATIC TRANSFER SWITCHES

- A. Completely enclosed and mounted separately from the transfer switch unit.
- B. Microprocessor for sensing and logic control with inherent digital communications capability.
- C. Plug-in, industrial grade Interfacing relays with dust covers.
- D. Connected to transfer switch by wiring harness having keyed disconnect plug.
- E. Plug-in printed circuit boards for sensing and control logic.
- F. Adjustable solid state undervoltage sensors for all three phases of utility and for one phase of standby source:
 - 1. Pickup 85 to 100 percent nominal.
 - 2. Dropout 75 to 98 percent of pickup setting.
- G. Adjustable frequency sensors for standby source:
 - 1. Pickup 90 to 100 percent nominal.
 - 2. Dropout 87 to 89 percent of pickup setting.
- H. Control module with adjustable time delays:
 - 1. 0.5- to 6-second engine start delay.
 - 2. 0- to 5-minute load transfer to emergency delay.
 - 3. 0- to 30-minute retransfer to normal delay.
 - 4. 0- to 30-minute unload running time delay.
 - 5. Switch to bypass any of the above time delays during testing.

SECTION 16412 – AUTOMATIC TRANSFER SWITCHES

- I. Form-C start contacts, rated 10 amperes, 32-volt dc, for two-wire engine control, wired to terminal block.
- J. In-phase monitor to control transfer when both sources are within acceptable phase angle limits, or adjustable pneumatic type time delay relay for time-delay-in neutral position.
- K. Adjustable 0 to 5 minutes time delay relay for engine starting signal.

2.6 METERING INSTRUMENTS

- A. Meters to be connected to load side of transfer switch.
- B. Ammeter.
- C. Voltmeter

2.7 INDICATORS

- A. Type: Manufacturer's standard.
- B. Green lens to indicate switch position for utility.
- C. Red lens to indicate switch position for standby power source.
- D. White lens to indicate utility power source is available within parameters established by pickup and dropout settings.
- E. Amber lens to indicate standby power source is available within parameters established by pickup and dropout settings.
- F. Provide one normally open and one normally closed, 5 amperes, 120-volt contact for remote indication when transfer switch is in either position.

2.8 FACTORY TESTS

- A. Test to Ensure Correct:
 - 1. Operation of individual components.
 - 2. Sequence of operation.
 - 3. Transfer time, voltage, frequency, and time delay settings.
- B. Dielectric strength test per NEMA ICS 1.

SECTION 16412 – AUTOMATIC TRANSFER SWITCHES

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

**** END OF SECTION ****

SECTION 16421 – SURGE ARRESTORS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide surge arrestors for the protection of electrical power equipment against surges caused by lightning or switching, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 16050 Basic Electrical Materials and Methods
 - 3. Section 16400 Low Voltage Electrical Service and Distribution

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI C 62.1 Surge Arrestors for AC Power Circuits
 - 2. NEMA LA 1 Surge Arrestors
 - 3. UL 1449 Clamp Voltage Documentation
 - 4. NFPA 70 National Electrical Code

1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit shop Drawings and catalog data in accordance with Section 01300 - Submittals.
 - 1. Catalog literature for arrestors proposed for installation; submittal shall identify materials, ratings, loss, dimensions.
 - 2. Shop Drawings showing arrestor mounting.
 - 3. Certified test data and individual test data for arrestors.
 - 4. Operation and maintenance data.

SECTION 16421 – SURGE ARRESTORS

PART 2 -- PRODUCTS

2.1 GENERAL

A. Secondary Service Suppressors for Low Voltage Panels:

1. Surge protective devices shall be installed at designated panels indicated on the single line diagrams.
2. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground.
3. Visible indication of proper suppressor connection and operation shall be provided.
4. The surge protective device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
5. The suppressor shall exhibit Sine Wave Tracking circuitry. The surge suppressor shall have suppression circuitry that is field replaceable without disturbing the conduit or enclosure.
6. Suppressors shall meet or exceed the following:
 - a. Minimum single impulse current rating (L-N + L-G): 80,000 A per phase.
 - b. UL clamping voltage shall not exceed the following:

Voltage	L-N	L-G	N-G
120/208	400V	400V	400V
277/480	800V	800V	800V

7. Suppressors shall consist of solid-state components and operate bi-directionally. The manufacturer of the surge panel shall offer either a surface or flush cover, as required by the job conditions.
8. Maximum continuous operating voltage of the suppressor shall be greater than 110 percent of the nominal system voltage.

SECTION 16421 – SURGE ARRESTORS

9. Manufacturers, or equal:
 - a. EFI Electronics Corporation, Titan BP Series.
 - b. Phoenix Contact, Trabtech.
 - c. Current Technology, DPA Series.
 - d. MCG Surge Protection

2.2 MOUNTING

- A. The manufacturer shall provide all the necessary mounting hardware.

2.3 FACTORY TESTS

- A. The manufacturer shall provide copies of design test data on the arrester provided showing that the arrestors are in compliance with ANSI C62.1-Surge Arrestors for AC Power Circuits.
- B. The following tests shall be made on each arrester intended for the service entrance in conformance with ANSI 62.1:
 1. Power-frequency spark-over.
 2. Radio influence voltage.
 3. Sealing.
- C. The design test data and the individual arrester test results shall be certified and submitted.

2.4 WARRANTY

- A. The surge arrester/suppressor manufacturer shall warrant the surge protective devices and supporting components, against defects in material and workmanship for a period of 5 years. The warranty shall include cost of component replacement, labor, travel and living expenses, all at no increased cost to the OWNER.

PART 3 -- EXECUTION

3.1 SERVICE ENTRANCE

- A. The CONTRACTOR shall install one primary suppressor at each utility service entrance or as indicated on the single line diagram. Installation shall be performed in accordance with the manufacturer's installation instructions.
- B. The suppressor shall be installed within the Motor Control Center.

SECTION 16421 – SURGE ARRESTORS

- C. Conductors between the suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. The lead length of connecting conductors shall be within 36 inches.
- D. The suppressor's ground shall be bonded to the service entrance ground.

**** END OF SECTION ****

SECTION 16431 – ELECTRICAL SYSTEMS ANALYSIS

PART 1 -- GENERAL

1.1 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

Except as otherwise indicated, the current editions of the following apply to the Work of this Section:

1. ANSI
2. IEEE C57.12.00 Liquid-Immersed Distribution, Power, and Regulating Transformers
3. IEEE 242 Protection and Coordination of Industrial and Commercial Power Systems
4. IEEE 399 Industrial and Commercial Power System Analysis
5. IEEE 1584 Guide for Performing Arc Flash Hazard Calculations
6. NEMA Z535.4 Product Safety Signs and Labels
7. NFPA 70 National Electrical Code
8. NFPA 70E Electrical Safety in the Workplace
9. OSHA 29 CFR, Part 1910 Subpart S, Electrical

3.3 RELATED SECTIONS

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

1. Section 01300 Submittals
2. Section 13300 Instrumentation and Control
3. Section 16950 Electrical Tests

1.3 SUBMITTALS

A. Action Submittals:

1. Short circuit study.
2. Protective Device Coordination Study: Submit within 90 days after approval of short circuit study.
3. Arc flash study.

SECTION 16431 – ELECTRICAL SYSTEMS ANALYSIS

4. Arc flash warning labels.

1.4 QUALITY ASSURANCE

- A. Short circuit and protective device coordination and arc flash studies shall be prepared by a professional electrical engineer registered in the State of California.

1.5 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before RESIDENT ENGINEER will review Shop Drawings for modifications to existing switchboard equipment (MSA-1 and MSA-2) in existing electrical building and for new motor control center in Electrical Equipment Enclosure (EEE).
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.
- C. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.
- D. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- E. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.6 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.
- B. Perform studies using one of the following electrical engineering software packages:
 1. SKM Power Tools for Windows.
 2. ETAP.
 3. Easy Power.
- C. Perform complete fault calculations for each existing source combination.
 1. Source combination may include present and future power company supply circuits, large motors, or generators.

SECTION 16431 – ELECTRICAL SYSTEMS ANALYSIS

- D. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.7 SHORT CIRCUIT STUDY

A. General:

1. Prepare in accordance with IEEE 399.
2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
4. Use cable and bus resistances calculated at 25 degrees C.
5. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN and XHHW conductors.
6. Use transformer impedances 92.5 percent of “nominal” impedance based on tolerances specified in IEEE C57.12.00.

B. Provide:

1. Calculation methods and assumptions.
2. Typical calculation.
3. Tabulations of calculated quantities.
4. Results, conclusions, and recommendations.
5. Selected base per unit quantities.
6. One-line diagrams.
7. Source impedance data, including electric utility system and motor fault contribution characteristics.
8. Impedance diagrams.
9. Zero-sequence impedance diagrams.

C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:

1. Existing main switchboards MSA-1 and MSA-2.
2. New low-voltage motor control center.

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3. Existing Emergency generator.
 4. Branch circuit panelboards.
 5. New adjustable frequency drives for recycled water pumps.
 6. Future load contributions as shown on one-line diagram.
- D. Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.
- E. Verify:
1. Equipment and protective devices are applied within their ratings.
 2. Adequacy of motor control center bus bars to withstand short circuit stresses.
 3. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.
- F. Tabulations:
1. General Data:
 - a. Short circuit reactances of rotating machines.
 - b. Cable and conduit material data.
 - c. Bus data.
 - d. Transformer data.
 - e. Circuit resistance and reactance values.
 2. Short Circuit Data (for each source combination):
 - a. Fault impedances.
 - b. X to R ratios.
 - c. Asymmetry factors.
 - d. Motor contributions.
 - e. Short circuit kVA.
 - f. Symmetrical and asymmetrical fault currents.
 3. Equipment Evaluation:

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- a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway
 - b. Maximum fault current available.
 - G. Written Summary:
 - 1. Scope of studies performed.
 - 2. Explanation of bus and branch numbering system.
 - 3. Prevailing conditions.
 - 4. Selected equipment deficiencies.
 - 5. Results of short circuit study.
 - 6. Comments or suggestions.
 - H. Suggest changes and additions to equipment rating and/or characteristics.
 - I. Notify District in writing of existing circuit protective devices improperly rated for new fault conditions.
- 1.8 PROTECTIVE DEVICE COORDINATION STUDY
- A. General:
 - 1. Prepare in accordance with IEEE 242.
 - 2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.

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- d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.
- B. Plot Characteristics on Curve Sheets:
- 1. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 2. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
 - 3. Pertinent transformer full-load currents at 100 percent.
 - 4. Transformer magnetizing inrush currents.
 - 5. Transformer damage curves; appropriate for system operation and location.
 - 6. ANSI transformer with stand parameters.
 - 7. Significant symmetrical and asymmetrical fault currents.
 - 8. Ground fault protective device settings.
 - 9. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
- C. Primary Protective Device Settings for Delta-Wye Connected Transformer:
- 1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
 - 2. Secondary Line-To-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.
- D. Tabulate Recommended Protective Device Settings:
- 1. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.

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- c. Adjustable time delays.
- d. Adjustable instantaneous pickups.
- e. I2t In/Out.
- f. Zone interlocking.
- g. Electronic settings data file.

E. Written Summary:

- 1. Scope of studies performed.
- 2. Summary of protective device coordination methodology.
- 3. Prevailing conditions.
- 4. Selected equipment deficiencies.
- 5. Results of coordination study.
- 6. Appendix of complete relay and circuit breaker electronic setting files
- 7. Comments or suggestions.

1.9 ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- C. Base Calculation: For each major part of electrical power system, determine the following:
 - 1. Flash hazard protection boundary.
 - 2. Limited approach boundary.
 - 3. Restricted approach boundary.
 - 4. Prohibited approach boundary.
 - 5. Incident energy level.
 - 6. Personal protection equipment (PPE) hazard/risk category.

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7. Type of PPE required.
- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
1. Bus name.
 2. Bus voltage.
- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
1. Bus name.
 2. Upstream protective device name, type, and settings.
 3. Bus line-to-line voltage.
- F. Produce arc flash evaluation summary sheet listing the following additional items:
1. Bus name.
 2. Upstream protective device name, type, settings.
 3. Bus line-to-line voltage.
 4. Bus bolted fault.
 5. Protective device bolted fault current.
 6. Arcing fault current.
 7. Protective device trip/delay time.
 8. Breaker opening time.
 9. Solidly grounded column.
 10. Equipment type.
 11. Gap.
 12. Arc flash boundary.
 13. Working distance.
 14. Incident energy.
 15. Required protective fire rated clothing type and class.

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- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm². Propose approaches to reduce energy levels.
- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
1. Equipment manufacturer's information used to prepare study.
 2. Assumptions made during study.
 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
 4. Arc flash evaluations summary spreadsheet.
 5. Bus detail sheets.
 6. Arc flash warning labels printed in color on adhesive backed labels.

PART 2 – PRODUCTS

2.1 ARC FLASH WARNING LABELS

- A. Printed in multicolor on adhesive backed labels an example label is located following end of section in Figure 1.

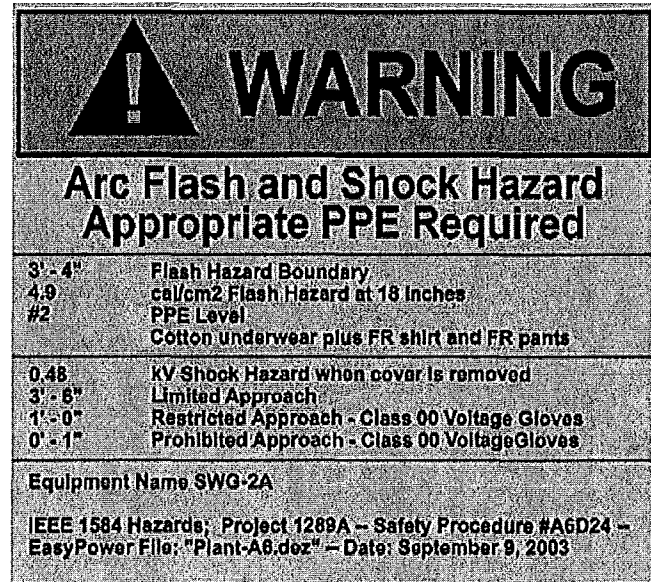


Figure 1
Example Arc Flash Label

SECTION 16431 – ELECTRICAL SYSTEMS ANALYSIS

PART 3 -- EXECUTION

3.1 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of required major equipment modifications.
- D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- E. Provide arc flash warning labels on equipment as specified in this section.

3.2 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is a part of this Specification:
 - 1. Figure 1: Example Arc Flash Label.

**** END OF SECTION ****

SECTION 16480 – MOTOR CONTROL CENTER

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide all motor control centers (MCCs) complete and operable, in accordance with the CONTRACT DOCUMENTS.
- B. If motors provided are different from those indicated, then the installation of raceway, conductors, starters, overload elements, and branch circuit protection shall be adjusted as required to control and protect the motor.
- C. The MCC shall be designed, tested and assembled in accordance with the applicable standards of IEEE, NEMA and ANSI.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 16050 Basic Electrical Materials and Methods
 - 3. Section 16400 Low Voltage Electrical Service and Distribution
 - 4. Section 16431 Short Circuit and Coordination Report
 - 5. Section 16485 Local Control Panels
 - 6. Section 16950 Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Unless otherwise specified, the current editions of the following apply to the Work of this Section:
 - 1. ANSI Standard Techniques Dielectric Tests.
 - 2. NEMA AB-1, ICS-1, ICS-2 National Electrical Manufacturers Association.
 - 3. NFPA 70 National Electrical Code.
 - 4. UL 489 Molded Case Circuit Breakers
 - 5. UL 845 Motor Control Centers

SECTION 16480 – MOTOR CONTROL CENTER

6. UL 508 Industrial Control Equipment

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop Drawings of all MCCs and components in accordance with the requirements of Section 01300 - Submittals and Section 16050 - Basic Electrical Materials and Methods.
- B. Complete data shall be submitted with the MCC shop Drawings. Submittals with Drawings not meeting this requirement will not be reviewed further and will be rejected. The shop Drawings shall include the following as a minimum:
1. Enclosure NEMA rating and color.
 2. Horizontal and vertical bus ampacities, voltage rating and interrupting capacity. Include materials of construction.
 3. Ground bus size and material of construction.
 4. Conduit entrance provisions.
 5. Main incoming line entry provision (top or bottom).
 6. Nameplate engraving legends.
 7. All circuit breaker types, frames and settings.
 8. All starter NEMA sizes, auxiliary contact provisions, coil voltage.
 9. Relays, timers, pilot devices, control transformer VA and fuse sizes.
 10. Elementary schematic ladder diagrams for each compartment. Custom schematics shall be furnished. MCCs shall be constructed and submitted in strict accordance with NEMA Class II S, Type B construction and diagrams shall include all remote devices.
 11. Short circuit rating of the complete assembly.
 12. Replacement parts lists and operation and maintenance procedures.
 13. Seismic design certification of the anchoring system in accordance with 16050-Electrical General Provisions.
 14. Time-current curves for all protective devices.

1.5 QUALITY ASSURANCE

SECTION 16480 – MOTOR CONTROL CENTER

- A. All materials shall be inspected in accordance with Section 16050 - Basic Electrical Materials and Methods.
- B. MCCs shall be stored in a clean, dry space. Factory wrapping shall be maintained, or an additional heavy plastic cover shall be provided to protect units from dirt, water, construction debris, and traffic. Storage space shall be heated or MCC space heaters shall be energized.
- C. MCCs shall be handled carefully to avoid damage to MCC components, enclosure, and finish.

1.6 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the RESIDENT ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Provide Seismic qualified equipment as follows:

The equipment and major components shall be suitable for and certified **by actual seismic testing** to meet all applicable seismic requirements of the 2006 International Building Code (IBC) Site Classification [Enter classification from above website]. The site coefficients $F_a =$ [Enter value from above website], and spectral response accelerations of $S_S =$ [Enter value from above website]g, $S_1 =$ [Enter value from above website]g are used. The test response spectrum shall be based upon a 5 percent damping factor, and a peak (SDS) of at least [Enter value from above website]g's (3 -12 Hz) applied at the base of the equipment in the horizontal direction. The forces in the vertical direction shall be at least 66 percent of those in the horizontal direction. The tests shall cover a frequency range from 1 to 100Hz. Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for

1.7 WARRANTY

- A. The system warranty shall be not less than one year after the date of Substantial Completion and shall include all costs for repair, parts, travel and living expenses, and labor.

SECTION 16480 – MOTOR CONTROL CENTER

PART 2 -- PRODUCTS

2.1 GENERAL

- A. MCCs shall conform to the standards for NEMA Class IIS, type B assemblies.
- B. MCCs shall be Cutler Hammer 2100, or equal.

2.2 DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

- A. The MCC shall be 600-V class suitable for operation on a three-phase, 60-Hz system. The system operating voltage and number of wires shall be as indicated.
- B. A continuous copper ground bus shall be provided with full width of the MCC line-up.
- C. The MCC receives power from a three phase, wye connected 277/480 V transformer with a grounded neutral. Power distribution from the MCC will be 480 V, three-phase, three-wire, however the MCC shall include provision for termination of an incoming neutral conductor in conformance to NEC requirements for service entrance.
- D. Structural members shall be fabricated of not less than 12 gauge steel and side and top panels and doors shall be not less than 14 gauge steel.
- E. The main horizontal copper bus shall be shielded front and rear with full width and height polyester barrier provided through each section and shall be supported by bus supports. Sections shall have wire gutters and split terminal blocks to permit easy withdrawal.
- F. A separate vertical wireway shall be provided adjacent to each vertical unit, and shall be covered by a hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the vertical wireway without disturbing adjacent unit components.
- G. Enclosures shall be NEMA Type 12. Compartment door shall be interlocked with compartment circuit breakers. The interlock shall be fitted with a maintenance override.
- H. Motor control sections shall be nominally 90 inches high and 20 inches (minimum) deep for front-mounted units, unless otherwise indicated.
- I. The main horizontal bus shall be copper with a capacity of 600 A minimum, but in no case less than the main lug or main breaker frame sizes. Main bus shall be copper, tin or silver-plated, enclosed in an isolated compartment.
- J. The vertical bus in each section shall consist of a single silver-plated copper conductor per phase with a current capacity of not less than 300 A. The vertical

SECTION 16480 – MOTOR CONTROL CENTER

bus shall be completely isolated and insulated, and shall extend the full height of the section wherever possible.

- K. All power buses shall be braced to withstand 42,000 A.
- L. Feeder breakers and motor circuit protectors shall have a withstand rating of not less than 42,000 amp symmetrical interrupting capacity. Current limiters will be acceptable, only as part of a motor starter, to meet this requirement.
- M. Spaces designated as "SPACE" or "BLANK" shall include blank hinged doors and vertical bus bars.
- N. The control center shall be of size to accommodate the equipment, but the overall length must be as shown where critical with respect to the allotted space.
- O. Each control unit (including spares, spaces and blanks), light and device shall be identified by a small nameplate. Identification shall include circuit number as indicated on the Drawings.
- P. Control units inside compartments shall be clearly identified with tags or stencil markings.
- Q. Finish for MCC shall be ANSI 61. The panels shall be given two coats of primer inside and out and two coats of enamel finish. External colors other than ANSI 61 will not be acceptable.
- R. Circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the "open" position.
- S. Fully rated continuous copper neutral bus shall be furnished through the control center. Lugs of appropriate capacity shall also be furnished.
- T. Motor circuit breaker or MCP shall be fitted with a "C" contact wired to terminals to be used for remote indication of device position.
- U. Where "L" or "U" shaped MCC layouts are shown, corner compartments shall have similar current and short circuit ratings as functional compartments.
- V. MCCs shall not be designed to exceed the space requirements indicated on the Contract Drawings, including spaces, spares and future compartments. MCCs shall be subject to rejection for exceeding the lengths indicated.
- W. Equipment within the MCC may be rearranged at the discretion of the manufacturer, providing the MCC includes not less than the spares, space and future provisions indicated.
- X. Manufacturers who do not meet at least the above requirements will be rejected.

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2.3 MOTOR STARTERS

- A. Motor starters shall be mounted in standard MCC assemblies, arranged essentially as indicated.
- B. Each motor starter unit shall consist of a combination magnetic contactor and short circuit protective device, all mounted in a completely enclosed cubicle. Short circuit protective device shall be an instantaneous, magnetic only circuit breaker, Westinghouse Type HMCP, Square-D Motor Circuit Protector, or equal. All circuit breakers provided as part of a motor starter unit shall be capable of being padlocked in the open position. Reset of thermal overload elements shall be possible with unit door closed. Three phase overload trip units shall be furnished to suit the full load current of the equipment installed. Overload trip unit shall be adjusted as required for power factor correction capacitors.
- C. Magnetic starters shall have auxiliary contacts as required by electrical motor control diagrams including one spare, N-O, and N-C contacts as indicated. The combination motor starters shall be drawout-type for size 5 and below. The fixed-type unit assembly shall be so constructed that it can be easily removed from its panel after disconnecting the wires to the terminal block and with Drawing from the primary bus. Removal of a unit assembly shall be possible without rear access and without disturbing any other unit in the MCC.
- D. Each starter unit shall have its own control power transformer. It shall have a 115-V grounded secondary. One secondary fuse and two primary fuses shall be provided. Unit control power transformers shall be sized to accommodate the control devices indicated. Local control devices shall be mounted independently of the cover door. All starters shall have a local "red" running lamp, a "green" off light to indicate the presence of control power when the motor is not running. Starters shall be provided with elapsed time meters, hand/off/auto selector switches, and other devices, as specifically indicated. All cubicle control wires shall be terminated at a disconnecting (pull-apart) terminal block at the cubicle.
- E. The MCC manufacturer shall be responsible for identifying each control wire within each motor starter unit with wrap-around permanent plastic markers. Each control wire shall be identified at both ends.
- F. Full voltage motor starter units shall be NEMA Size 1 or larger. The combination starters shall be rated for a minimum 42,000 RMS symmetrical amperes.
- G. Motor starters shall be designed to NEMA standards. Starters designed to IEC standards or with dual IEC/NEMA ratings will not be acceptable, either as part of any MCC, as remote starters, or as part of an equipment package.

SECTION 16480 – MOTOR CONTROL CENTER

- H. Reduced voltage starters shall be of the solid state type with a full bypass starter, Cutler-Hammer S800 Series, or equal.
- I. Reduced Voltage Motor Starter Type S811
 - 1. Controller shall be Cutler-Hammer type S811 or equal.
 - 2. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing.
 - 3. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV.
 - 4. Units using triacs or SCR/diode combinations shall not be acceptable
 - 5. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects.
 - 6. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.
 - 7. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.
 - 8. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current.
 - 9. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
 - 10. Digital interface module mounted on the face of the S811 shall be used to program the soft starter. Display shall include six line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions.
 - 11. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via digital interface module.

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12. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100 percent of the maximum continuous ampere rating of the starter.
13. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad.
14. Starter shall be capable of either an electronic or mechanical reset after a fault.
15. Units using bimetal overload relays are not acceptable.
16. Overtemperature protection (on heat sink) shall be standard.
17. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via digital interface module.
18. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50 percent current differential between any two phases is encountered. This feature can be disabled via digital interface module.
19. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via digital interface module.
20. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via digital interface module.
21. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload)
22. The following control function adjustments from digital interface module are required:
 1. Selectable Torque Ramp Start or Current Limit Start.
 2. Adjustable Kick Start Time: 0–2 seconds.
 3. Adjustable Kick Start Torque: 0–85 percent.
 4. Adjustable Ramp Start Time: 0.5–180 seconds.
 5. Adjustable Initial Starting Ramp Torque: 0–85 percent.

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6. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
 23. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues
 24. Maximum continuous operation shall be at 115 percent of continuous ampere rating Pump Control Option – Provide control algorithm for pump start-up and shut down sequences. Control algorithm shall reduce the potential for water hammer in a centrifugal pump system. Upon a start command, the speed of the motor is increased, under the control of the IT. Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements. The pump control option shall be factory installed.
 - I. Two-speed starters shall be of the two-winding type.
 - J. Each MCC shall be fitted with the manufacturer's nameplate which shall include the NEMA Standard electric rating and other pertinent data, including sales order number, date of manufacturer, and place of manufacture.
 - K. Transient surge suppressors shall be provided in each starter. Suppressor shall be encapsulated in a small module suitable for mounting directly to the starter.
- 2.4 MAIN AND FEEDER CIRCUIT BREAKERS (480 V)
- A. Circuit breakers having a frame size of 150 A or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.
 - B. Circuit breakers with a frame size of 225 to 1,200 A shall be molded case with RMS sensing electronic trip elements.
 - C. The interrupting capacity of all main, and feeder branch circuit breakers shall be a minimum of 42,000 RMS symmetrical amperes.
- 2.5 MOTOR STARTERS -- UNIT MOUNTED
- A. Unit-mounted motor starters shall consist of individual units mounted in close proximity to the machinery controlled.
 - B. Magnetic starters shall be the combination circuit breaker type with cover interlocked with circuit breaker handle; unit shall have control power

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transformer and panel mounted control devices all as specified for group-mounted starters in MCCs.

- C. Manual starters shall have 2-pole thermal overload elements and shall have auxiliary control devices as shown. Operating handle shall be trip-free and shall be indicated "On", "Off" or "Tripped" positions.

2.6 CONTROL DEVICES

- C. Products of the same type shall be of the same make. This requirement applies to all control devices, and insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this Project.
- D. Pushbuttons, lights, and selector switches shall be of the same manufacturer as the MCC. Control devices shall be heavy duty, oil tight type. Contact rating shall be 10 A.
- E. All control devices shall be in conformance of the requirements of Section 16485 - Local Control Panels.
- F. Provide solid-state type metering where indicated. Include CTs and PTs of ratios as indicated. Solid state metering shall be Multilin MTM, Cutler-Hammer "IQ Data Plus II", or equal.

2.7 SPARE PARTS

- A. The CONTRACTOR shall furnish loose one unit control transformer of each size furnished in magnetic starters installed, three bezels of each color installed for pilot indicators, one dozen panel lamps, and one dozen control fuses of each size installed.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall install the MCC in accordance with the manufacturer's published instructions. Conduit installation shall be coordinated with Manufacturer's as-built Drawings so that all conduit stub-ups are within the area allotted for conduit. Conduit shall be stubbed up in the section that contains the devices to which conductors are terminated.

3.2 INSTALLATION

- A. MCCs shall be installed on 4-inch concrete pads. After leveling and shimming, anchor MCC to concrete pad, and grout in place so that no space exists between the pad and support beams.
- B. The CONTRACTOR shall:

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1. Torque all bus bar bolts to manufacturer's recommendations; tighten all sheet metal and structure assembly bolts.
2. Adjust all MCP devices to the instantaneous trip setting position recommended for the actual horsepower and full load amps of the motor. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors having power factor correcting capacitors.
3. After equipment is installed, touch up scratches, and verify that nameplate, and other identification is accurate and in compliance with these requirements.
4. Furnish and install high voltage switchboard matting in front of the MCC. The mat shall be 1/4-inch thick and 36 inches wide and shall be Model M36 as manufactured by W.H. Salisbury & Co., or equal.

3.3 FACTORY TESTS

- A. All MCCs, and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports submitted for approval. The tests shall include, electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components, including controls, protective devices, metering, and alarm devices. The factory test reports shall be submitted with the production shop Drawings.

3.4 FIELD TESTING

- A. Visual and mechanical inspections by the CONSULTANT shall include the following:
 1. Inspect for physical damage, proper anchorage and grounding.
 2. Verify overload heaters with motor full load current for proper size.
 3. Check tightness of bolted connections.
- B. Electrical Tests
 1. Insulation tests shall include the following:
 - a. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute. Test voltage and minimum acceptable values in accordance with manufacturer's recommendations.
 - b. Measure insulation resistance of each starter section phase to phase and phase to ground with the starter

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contacts closed and the protective device open. Test voltage and minimum acceptable values in accordance with manufacturer's recommendations.

- c. Measure insulation resistance of each control circuit with respect to ground
2. The CONTRACTOR shall verify proper operation of control logic in all modes of control.

**** END OF SECTION ****

SECTION 16485 – LOCAL CONTROL PANELS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide local control panels (LCPs) complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 13300 Instrumentation and Control
 - 3. Section 16050 Basic Electrical Materials and Methods
 - 4. Section 16400 Low Voltage Electrical Service and Distribution

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. LCPs shall comply with the requirements of NEC, NEMA, and UL.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop Drawings in accordance with Section 01300 - Submittals and Section 16050 - Basic Electrical Materials and Methods.
- B. Ladder diagrams and written descriptions explaining ladder diagrams operation and system operation shall be submitted.
- C. The CONTRACTOR shall submit catalog cuts of all control equipment including enclosures, overcurrent devices, relays, pilot devices, terminations, and wire troughs.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall provide LCPs to satisfy the functional requirements in other Sections and as indicated on the Drawings. Each LCP shall be fabricated with UL label components. Panels not specifically provided in other Sections shall be provided under this Section. LCPs shall be wired as provided in this Section.
- B. The LCP controls shall be 120 V maximum. Where the electrical power supply to the LCP is 240 V single phase, or 480 V, 3-phase, the LCPs shall be provided

SECTION 16485 – LOCAL CONTROL PANELS

with a fused control power transformer. Control conductors shall be provided in accordance with Section 16050 - Basic Electrical Materials and Methods.

- C. Each LCP shall be provided with identified terminal strips for the connection of all external conductors. Provide sufficient terminal blocks to connect 25% additional conductors for future use. Termination points shall be identified in accordance with accepted shop Drawings. The LCPs shall be the source of power for all 120 VAC solenoid valves interconnected with the LCPs. All equipment associated with the LCPs shall be ready for service after connection of conductors to equipment, controls, and LCPs. Terminal strips for AC and DC signal wires shall be separated from each other.
- D. All internal wiring shall be factory-installed and shall be contained in plastic wireways having removable covers. Wiring to door-mounted devices shall be extra flexible and be anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals. DC and AC control signal wires shall be installed in separate wireways.
- E. Enclosures:
 - 1. In finished rooms, enclosures shall be NEMA 12 painted steel enclosures with ANSI 61 exterior and white interior. Enclosures shall be Hoffman or equal.
 - 2. In all other non-hazardous areas enclosures, shall be NEMA 4X stainless steel (before modifications) with brushed finish. Where possible, penetrations shall be made in such a manner to maintain the NEMA 4X rating. If this is not possible, the penetrations shall be made in such a manner to minimize entry of foreign materials into the enclosure. Enclosures shall be Hoffman or equal.
 - 3. In hazardous areas, enclosures shall be cast aluminum NEMA 7 and shall be UL Listed for use in hazardous or classified locations. Enclosures shall be Crouse-Hinds or Appleton.
 - 4. Enclosures shall be either freestanding, pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on a removable mounting pan. The mounting pan shall be finished white. Enclosure shall include a fluorescent light fixture, a light switch, and duplex receptacle, all controlled by 15 A circuit breaker.
- F. The main feeder disconnect shall have a door-mounted handle unless otherwise indicated.

SECTION 16485 – LOCAL CONTROL PANELS

- G. Identification of panel-mounted devices, conductors, and electrical components shall meet the requirements specified in Section 16050 - Basic Electrical Materials and Methods.
- H. All panel-mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 LCP COMPONENTS

- A. Pushbuttons, selector switches, and pilot lights shall be of the heavy-duty, oil-tight type sized to 30 mm. Miniature style devices are not acceptable. Devices shall be as manufactured by Square-D, Allen-Bradley, or equal.
 - 1. Lens colors shall be green for "run," "open," or "on"; red for "stopped," "closed," or "off;" amber for alarm.
 - 2. Pilot lights shall be full voltage LED cluster style.
 - 3. Provide hazardous location type pilot devices in classified locations.
- B. Relays shall be 3 PDT with 10 A contacts, plug-in type using rectangular blades and provided with sockets for screw-type termination and hold-down clips. Relays shall be as manufactured by Square D, Potter Brumfield, or equal.
- C. Elapsed time meters shall be non-resettable type, read to a maximum of 99999.9 hours and shall be as manufactured by Eagle Signal, EATON, or equal.
- D. Magnetic starters shall meet the following requirements:
 - 1. NEMA rated or Dual NEMA/IEC rated type.
 - 2. FVNR type unless indicated otherwise.
 - 3. Combination starters with magnetic only instantaneous trip circuit breakers such as EATON "MCP," Square-D, "Mag-Gard," or equal.
- E. Current-to-current converter/isolators shall be 4-20 mA input, 4-20 mA output for operation from 120 VAC power, and shall be by Moore, A.G.M., or equal.
- F. Process alarm relays shall have a 4-20 mA input and two independent SPST contact outputs as manufactured by A.G.M., or equal. Power input shall be 120 VAC.
- G. Digital indicators shall have 4-20 mA input and shall display the signal in process units. 0-100% as a displayed signal shall only be acceptable to indicate speed. Indicators shall be as manufactured by Newport, Red Lion, or equal for operation from 120 VAC. Splash-proof covers shall be provided in NEMA 4X panels, and viewing windows shall be provided in NEMA 7 panels.

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- H. Single and multi-loop controllers shall have the following features:
1. Analog and digital inputs and outputs as indicated on the Drawings.
 2. Process & Instrumentation Diagram control algorithms.
 3. Graphic display indicating input, setpoint and all alarms.
 4. Operate on 120 VAC. Face shall be approximately 3 inches wide by 6 inches high.
 5. Unit shall be provided completely programmed and ready for use. Include a portable programming device.
 6. Provide window kit for the LCP enclosure over all controllers.
 7. Unit shall be Fischer and Porter Model 53MC5000, or equal.
- I. Manual loading stations shall have 4-20 mA outputs and 4-20 mA inputs for remote or auto control. Switching from local and remote or from manual to auto shall be by means of controls on the face of the unit or by isolated contact closure as indicated on the Drawings. Provide window kit for the LCP enclosure over all manual loading stations. Manual loading station shall be as manufactured by Fischer and Porter, or equal.
- J. Time delay relays shall be combination on delay and off delay (selectable) with adjustable timing ranges. Time delay relays shall be Square D JCK70. Provide socket with screw terminal connections and retaining strap. Similar shall be by ATC, or equal.
- K. Programmable logic controller(s) (PLCs) may be supplied within the LCP in lieu of relays. Provided the PLCs match the PLCs furnished under Section 13374 – Control Panel Instrumentation.
- L. Reset Timers: Reset timers shall be synchronous motor driven with a solenoid operated clutch. Timer shall be on-delay for semi-flush panel-mounting. The timers shall be rated 120-V, 60 Hz, with 10-A rated contacts, and with time range as shown, and shall be Eagle Signal Division E.W. Bliss Company Bulletin 125, Automatic Timing and Controls, Inc., Type 305, or equal.

2.3 FACTORY TESTING

- A. Each LCP shall be factory assembled, and tested for sequence of operation before delivery to the jobsite. The RESIDENT ENGINEER reserves the right to witness factory tests.

2.4 SPARE PARTS

SECTION 16485 – LOCAL CONTROL PANELS

- A. The CONTRACTOR shall furnish a minimum of 10 percent spare lamps (minimum 2) and one spare lens for each color pilot lamp in each panel.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. LCPs shall be installed in accordance with Section 16050 - Basic Electrical Materials and Methods, and in accordance with the manufacturer's recommendations.
- B. LCPs shall be protected at the job site from loss, damage, and the effects of weather. LCPs shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion, and humidity.
- C. LCP interiors and exteriors shall be cleaned, and coatings shall be touched up to match original finish upon completion of the Work.
- D. Conduit, conductors, and terminations shall be installed in accordance with the Section 16050 - Basic Electrical Materials and Methods.
- E. A ground lug for a size No. 2 AWG bare copper conductor shall be included to ground LCP to the plant's grounding system.
- F. A copy of the final (as-built) wiring diagrams shall be placed in a metal pocket provided inside of the LCP door.

3.2 FIELD TESTING

- A. Each LCP shall be tested again for functional operation in the field after the connection of external conductors, and prior to equipment startup.

**** END OF SECTION ****

SECTION 16500 – LIGHTING

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide lighting fixtures, and accessories for all lighting systems, complete and operable, in accordance with the CONTRACT DOCUMENTS.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 16050 Basic Electrical Materials and Methods

1.3 STANDARD SPECIFICATIONS

- A. Except as otherwise indicated, the CONTRACTOR shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), including the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. National Electric Code (NEC)
 - 2. California Building Code (UBC)
 - 3. Underwriters Laboratories (UL)
 - 4. ANSI C82.1 Specifications for Fluorescent Lamp Ballasts
 - 5. ANSI C84.4 Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type)
 - 6. Standards of the Certified Ballast Manufacturer's Association

1.5 CONTRACTOR SUBMITTALS

- A. Submit the following in accordance with the requirements of Section 01300 - Submittals.
 - 1. Shop drawings and catalog data.

SECTION 16500 – LIGHTING

2. Catalog literature for each fixture. Each such submittal shall clearly describe materials, type of diffuser, hardware, gasketing, reflector and chassis, finish, and ballast.
 3. Ballast catalog data indicating lamp wattage, input watts, sound rating, power factor, and type of ballast. Data for outdoor ballast shall be include low temperature starting characteristics.
 4. Photocell data submittal shall indicate switching capacity, the means of adjusting the lighting pickup level, and enclosure.
- B. Substitutions for indicated fixtures shall be based upon quality of construction, light distribution, appearance, and maintenance.

1.6 QUALITY ASSURANCE

- A. Exterior lighting system operation shall be demonstrated during the hours of darkness to indicate that fixtures are properly focused, photocell operation is correct, and that fixture switching functions as intended. Similar requirements shall apply to interior lighting. Through demonstration, verify that panel schedules properly indicate the lighting outlets connected to each circuit.
- B. Lighting demonstration shall occur within 2 weeks before Project acceptance.
- C. Lighting fixtures shall be stored in their original cartons from the manufacturers until the time of installation. Fixtures poles shall be stored on blocks above grade until the time of installation.

1.7 CLEANUP

- A. Fixture lenses, diffusers, and reflectors shall be cleaned just before the system demonstrations.
- B. Fixture trim, including poles and support brackets, where finish has been damaged, shall be refinished.

PART 2 -- PRODUCTS

2.1 FIXTURES - GENERAL

- A. All fixtures shall be prewired with leads of 18-AWG, minimum, for connection to building circuits.

2.2 EXTERIOR FIXTURES

- A. Exterior fixtures in combination with their mounting pole and bracket shall be capable of withstanding 100-mph winds without damage. Exterior fixtures shall have corrosion - resistant hardware and hinged doors or lens retainer.

SECTION 16500 – LIGHTING

Fixtures to be furnished with integral photoelectrical control shall be of the fixture manufacturer's standard design.

2.3 INTERIOR FIXTURES

- A. Interior LED fixtures without diffusers shall be furnished with end plates. Where diffusers are required, they shall be of high molecular strength acrylic. Minimum thickness of the acrylic shall be 0.125 inches for all diffusers, except that those on 4-foot square fixtures shall be 0.187 inches thick.

2.4 LAMPS

- A. Lamps shall be GE, Phillips, Sylvania, or equal.

2.5 PHOTOELECTRIC CELLS

- A. Photoelectric cells for control of multiple fixtures shall be self-contained, weatherproof type and shall be provided with time-delay features.

2.6 LIGHT FIXTURE CONTROL RELAYS

- A. Relays for light fixtures control shall be mechanically held. Such relays shall be based mounted, single-purpose units, i.e., no attachments to a multi-purpose solenoid operator.
- B. If not indicated otherwise, coil voltage shall be 115 VAC with contacts rated at 20 A. Relays shall be ASCO Series 166, Zenith Series MSC, or equal.

2.7 EMERGENCY LIGHTING POWER SUPPLY

- A. See Drawings.

2.8 SPARE LAMPS

- A. Spares shall be provided for all lamp types except medium base incandescent lamps rated less than 300 W. The number of spares shall be equal to 5% of each rating type, with a minimum of one standard manufacturer's package.

PART 3 -- EXECUTION

3.1 LIGHTING FIXTURES

- A. Lighting fixtures shall be provided complete at each outlet in accordance with the Fixture Schedule.
- B. Lighting fixtures shall be installed plumb and square with building and wall intersections. Pendant-mounted fixtures which are mounted from sloping ceilings shall be suspended by ball hangers. Fixtures installed in machinery rooms shall be located after machines have been installed. In all cases, fixture

SECTION 16500 – LIGHTING

locations shall be coordinated with work of other trades to prevent obstruction of light from the fixtures.

3.2 FIXTURE POLES

- A. Fixture poles shall be set on anchor bolts and secured with double nuts on each bolt. After fixture has been leveled and plumbed, the fixture base shall be dry-packed.

**** END OF SECTION ****

SECTION 16640 – CATHODIC PROTECTION SYSTEM

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall provide a cathodic protection system for underground and underwater structures, including electrical connections, anodes, rectifiers, and test stations, and all accessories required for a complete and operable system, including testing the system after installation, in accordance with the CONTRACT DOCUMENTS.
- B. The CONTRACTOR shall retain a Registered Professional Engineer or 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 01300 Submittals
 - 2. Section 01720 Project Record Documents
 - 3. Section 02360 Ductile Iron Pipe
 - 4. Section 02650 Steel Pipe, Lined and Coated
 - 5. Section 02653 Fabricated Steel Pipe Specials
 - 6. Section 09800 Protective Coating

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designations only. The latest editions shall be used:
- B. Commercial Standards:
 - 1. ACI 301 Specifications for Structural Concrete for Buildings

SECTION 16640 – CATHODIC PROTECTION SYSTEM

- | | | |
|-----|----------------|--|
| 2. | ANSI C 34.2 | Practice and Requirements for Semiconductor Power Rectifiers |
| 3. | ANSI C 80.1 | Rigid Steel Conduit-Zinc Coated |
| 4. | ASTM A 53 | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| 5. | ASTM A 497 | Steel Welded Wire Fabric, Deformed, for Concrete Locator Code |
| 6. | ASTM A 615 | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| 7. | ASTM B 124 | Copper and Copper Alloy Forging Rod, Bar and Shapes |
| 8. | ASTM B 418 | Cast and Wrought Galvanic Zinc Anodes |
| 9. | ASTM C 150 | Portland Cement |
| 10. | ASTM D 1785 | Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| 11. | Bulletin 74-90 | California Well Standards (Supplement to 74-81) |
| 12. | FS W-C-1094 | Conduit and Conduit Fittings, Plastic, Rigid |
| 13. | IEEE C57.12.56 | Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers |
| 14. | NACE RP0169 | Standard Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems |

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15.	NEMA MR 20	Semiconductor Rectifier Cathodic Protection Units
16.	NEMA WC 3	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
17.	NEMA TC 3	PVC Fittings for Use with Rigid PVC Conduit and Tubing
18.	NEMA WC 5	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1985)
19.	NEMA WC 7	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
20.	NEMA 250	Enclosures for Electrical Equipment (1,000 V maximum)
21.	NFPA 70	National Electrical Code (NEC)
22.	SSPC SP-1	Solvent Cleaning
23.	SSPC SP-6	Commercial Blast Cleaning

1.4 DEFINITIONS

- A. **CONTRACTOR:** The fully licensed prime installation CONTRACTOR selected by the OWNER to install the pipeline.
- B. **OWNER:** The OWNER is the City of San Diego.
- C. **CORROSION ENGINEER:** A qualified corrosion engineer retained by the CONTRACTOR who is either a Registered Professional CORROSION ENGINEER in the State of California or a NACE International certified Cathodic Protection Specialist and who can demonstrate at least five years of experience with the design and implementation of cathodic protection systems on buried piping.

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- D. RESIDENT ENGINEER: The City of San Diego's Resident Engineer or his designated representative.
- E. CITY'S CORROSION ENGINEER: The designated representative of the City's Corrosion Engineering Department.

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. Operations and Maintenance Information: The CONTRACTOR shall submit operation and maintenance related information in accordance with Section 01730 - Operations and Maintenance Information, including an electrical schematic of the rectifier, rectifier field test reports, parts list with part replacement numbers, and troubleshooting procedures.
- D. Test and Inspection Reports: The CONTRACTOR shall submit field test and inspection reports, along with wiring diagrams of the installed system.
- E. Anode Current Measurements: The CONTRACTOR shall tabulate and submit all structure-to-soil and anode current measurements, including the date of the measurement and the test location.
- F. Qualifications: All work shall be performed by qualified, experienced personnel working under continuous, competent supervision. Qualified contractors must demonstrate at least five years of experience with Cathodic Protection Installations.
- G. Record Documents: The CONTRACTOR shall submit Record Documents in accordance with SSPWC 2-5.3.

1.6 PACKAGING AND SHIPPING

- A. The CONTRACTOR shall coil wires, secure and package anodes as required to prevent damage during shipment.

SECTION 16640 – CATHODIC PROTECTION SYSTEM

PART 2 -- PRODUCTS

2.1 IMPRESSED CURRENT ANODES

A. Capacity. High potential magnesium anodes shall have a theoretical energy content of 1000 ampere-hours per pound and have a minimum useful output of 500 ampere-hours per pound.

B. Chemical Composition (High Potential Magnesium)

ASTM B843:

aluminum	0.01 percent
manganese	0.5 to 1.30 percent
zinc	-
copper	0.02 percent
nickel	0.001 percent
iron	0.03 percent
silicon	0.05 percent
calcium	
other metallic	0.05 percent
others, total	0.30 percent
magnesium remainder	

C. Open Circuit Potential. The open circuit potential of all anodes, buried in the soil, shall be between 1.55 and 1.75 volts dc versus a copper-copper sulfate reference electrode.

D. Ingot Size and Weight. Anodes shall be 48-pound prepackaged, high potential ingots with a trapezoidal cross section. Ingot length shall be 32 inches long. The total packaged weight shall be 105 lbs.

E. Anode Construction. Anodes shall be cast magnesium with a galvanized steel core rod recessed on one end to provide access to the rod for connection of the lead wire. Silver braze the lead wire to the rod and make the connection mechanically secure. Insulate the connection to a 600 volt rating by filling the recess with epoxy and covering any exposed bare steel core or wire with heat shrinkable tubing. The insulating tubing shall extend over the lead wire insulation by not less than ½ inch. The anode lead wire shall be stranded copper and shall be connected directly to the anode steel core as described above. There shall be NO wire splices between the anode steel core and the tag end at the test station.

F. Anode Pre-Packaged Backfill Material. The anodes shall be completely encased and centered within a permeable cloth bag in a special low resistivity backfill mix with the following composition:

Gypsum	75%
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SECTION 16640 – CATHODIC PROTECTION SYSTEM

Powdered bentonite 20%
Anhydrous sodium sulfate 5%

- G. Backfill grains shall be such that 100 percent is capable of passing through a screen of 100 mesh. Backfill shall be firmly packed around the anode such that the ingot is approximately in the center of the backfill. The resistivity of the backfill shall be no greater than 50 ohm-cm when tested wet in a soil box. Total prepackaged weight shall be approximately 105 pounds

2.2 WIRE AND CABLE

- A. All wires shall be stranded copper with HMWPE or THWN insulation suitable for direct burial in corrosive soil and water, conforming to UL 83 and ASTM standards B3 or B8. HMWPE insulation shall conform to ASTM D1248 type 1, class c, grade 5. THWN insulation shall conform to ASTM D-2220.
- B. Test Leads to Pipeline. No. 6 AWG HMWPE for anode test stations, where shown on drawings.
- C. Anode Lead Wire. Anode lead wires shall be No. 12 AWG THWN (white).
- D. Mechanical Joint Bond Wire. No. 4 AWG HMWPE.
- E. Wire Connectors. All wire and copper connectors shall conform to UL 486-76.
- F. Wire Splicing. NO wire splicing is permitted.

2.3 CATHODIC PROTECTION TEST STATIONS

- A. Flush Mounted:
 - 1 Test Box: At-grade test boxes shall be round, pre-cast concrete, H-20 traffic rated, with a cast iron lid. Provide extensions as required to penetrate concrete surfaces by 4-inches minimum. Provide with a cast iron cover with the letters "CPTTEST."
 - 2 Test Box Manufacturer and Product: Brooks, 36 series; Christy, Model B9; or equal.
- B. Marker Post: Blue composite marker post 7-feet long with the following label:
 - 1. Cathodic Protection Test Station; Carsonite CUM-375, or equal.

SECTION 16640 – CATHODIC PROTECTION SYSTEM

- C. Identification Tags: All test leads shall be identified with an very label, self adhesive covered with polyolefin clear heat shrink tubing. The label shall include: name of facility – size – pipe material; type of insulation; station number. Brass tags may be used in lieu of Avery labels with approval of the RESIDENT ENGINEER.

2.4 THERMITE WELD MATERIALS

- A. General: Wire sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and material. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers will not be acceptable.

- B. Molds: Graphite. Ceramic "One-Shot" molds are not acceptable.

- C. Adapter Sleeves:

- 1 As required to match welder size to wire size.
- 2 Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Attach field-formed sleeves with the appropriate size and type of hammer die furnished by the thermite weld manufacturer.
- 3 Extend wire conductor 1/4 inch beyond the end of the sleeve.

- D. Welders and Cartridges: For attaching copper wire to pipe material:

Pipe Material	Weld Type	Cartridge Size, Max.
No. 4 AWG Wire & Smaller:		
Steel	HA, VS, HC	25 gm
No. 2 AWG Joint Bonds:		
Steel	FS	25 gm
Notes: HA = Horizontal Tap Weld HC = Horizontal Through Conductor Weld FS = Formed Sleeve VS = Vertical Surface		

- E. Manufacturers:

- 1 Erico Products Inc. (Cadweld), Cleveland, OH.
- 2 Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.
- 3 Or approved equal.

SECTION 16640 – CATHODIC PROTECTION SYSTEM

2.5 INSULATING JOINTS

- A. Insulating Joints: Dielectric unions, flanges, or couplings.
 - 1. Complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline.
 - 2. Materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.

- B. Flange Insulating Kits:
 - 1. Gaskets: Type "E" full-faced, NEMA LI-1 G-10 epoxy glass material with rectangular nitrile or Viton O-ring seal for operation between 20°F and 150°F. Gaskets shall be suitable for the temperature and pressure rating of the piping system in which they are installed.
 - 2. Insulating Sleeves: Full-length fiberglass-reinforced epoxy (NEMA LI-1, industrial laminated thermal setting products, G-10 grade).
 - 3. Insulating Washers: Fiberglass-reinforced epoxy (NEMA LI-1, industrial laminated thermal setting products, G-10 grade).
 - 4. Steel Washers: Plated, hot-rolled steel, 1/8-inch thick.
 - 5. Manufacturers, or Equal:
 - a. Pacific Seal, Inc., Burbank, CA.
 - b. Central Plastics Co., Shawnee, OK.

- C. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body, as manufactured by Central Plastics Co., Shawnee, OK, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Construct cathodic protection system, pipe bonds, electrical insulators, and test stations for buried structure and appurtenances.

- B. Conform to NFPA 70 and NACE RP0169.

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- C. CONTRACTOR Qualifications. All work shall be performed by qualified, experienced personnel working under continuous, competent supervision. Qualified Contractors must demonstrate at least five years of experience with cathodic protection installations.
- D. Test Results. The CONTRACTOR shall submit a CORROSION ENGINEER'S report including all test data, conclusions, repairs, and cathodic protection system performance.
- E. Notification for Testing. The CONTRACTOR shall notify the RESIDENT ENGINEER at least five days in advance of the anodes, insulators, and test station installations. The RESIDENT ENGINEER shall, at their discretion, witness the installation of all anodes and cathodic protection facilities. Testing shall be as described in this specification section.

3.2 MAGNESIUM ANODE INSTALLATION

- A. Inspection. All lead wires shall be inspected to ensure that the lead wire is securely connected to the anode core and that no damage has occurred to the lead wire. Lead wire failures shall require replacement of the complete anode and lead wire.
- B. Pre-Packaged Anode Inspection. Each anode shall be inspected to ensure that the backfill material completely surrounds the anode and that the cloth bag containing the anode and backfill material is intact. If the prepackaged anodes are supplied in a waterproof container or covering, that container or covering shall be removed before installation. The CONTRACTOR shall notify the RESIDENT ENGINEER at least five (5) days in advance of installing the anodes.
- C. Location. Anodes are to be installed in augured holes as noted in the drawings. Anode positions can be adjusted slightly to avoid interference with existing structures.
- D. Handling. Care shall be taken to ensure that the anode is never lifted, supported, transported, or handled by the lead wire. All anodes shall be lowered into the hole using a sling or a rope.
- E. Anode Hole Size and Depth. Anodes shall be placed vertically at the bottom of a 12 feet deep augured hole, 12 inches in diameter (minimum).
- F. Soaking Requirements, Pre-Packaged Anodes. Once the prepackaged anodes are in the hole, water shall be poured into the hole so that the anodes are completely covered with water. Allow the anodes to soak for a minimum of 30 minutes before any soil backfill is added.

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- G. Soil Backfill. After the pre-packaged anodes are soaked, the hole is backfilled with stone-free, native soil. No voids shall exist around the anode bags and the anode lead wire shall not be damaged. The backfill shall be tamped and compacted in 18 inch lifts above the anode taking care not to damage the anode lead wire.

3.3 PIPE JOINT BONDING

- A. General: Electrically bond the joints of buried steel pipe, buried ductile iron pipe, and buried welded steel pipe, including vault and manhole piping and fittings, and including restrained joints, except joints specified to be threaded, welded, or insulated.
- B. Bonding at Joints: Install two joint bond wire assemblies at each joint that requires bonding.
- C. Thermite Welding: Use thermite weld process for electrical connection of wires to pipe and fittings.
- D. Testing: Test each bonded joint for continuity.

3.4 TEST STATION INSTALLATION

- A. Locations: Determine the location of the test stations based on actual site conditions and as approved by the RESIDENT ENGINEER. Locate test stations as follows:
 - 1. Install a test station at insulated joints that are buried.
- 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. Install wire labels.

3.5 WIRE CONNECTIONS

- A. Thermite Weld:
 - 1. Use thermite weld method for electrical connection of copper wire to steel surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and

SECTION 16640 – CATHODIC PROTECTION SYSTEM

surface preparation recommended by the welder manufacturer. Assure that the pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the integrity of the pipe or fitting wall or protective lining.

2. After the weld connection has cooled, remove slag, visually inspect, and physically test wire connection by tapping with a hammer; remove and replace defective connections.
- B. Protective Coating: The CONTRACTOR shall furnish all materials, clean surfaces and repair any damage to protective coatings and linings damaged as a result of the welding in accordance with the requirements of Section 09800 - Protective Coating. A coating shall be applied to all exothermic weld locations. The coating for ductile iron or dielectrically coated steel shall be a bitumastic coating. The coating shall be covered with a plastic weld cap and bitumastic tape. All surfaces must be clean and dry and free of oil, dirt, loose particles and all other foreign materials before application of the coating. For cement mortar lined and coated pipe, the coating shall match the exterior mortar.

3.6 INSULATED JOINTS

- A. General: Install insulated joints to electrically isolate the pipeline from other structures. Locate insulated joints where cathodically protected pipe connects to pipe not intended to have cathodic protection, and where shown. Install a test station at each insulated joint as specified.
- B. Installation: Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.
- C. Coating: After assembly of insulated flanges, prepare cement-mortar surface in accordance with paint manufacturer's instructions and apply a 20-mil minimum thickness of epoxy coating to the interior of the pipeline. Apply coating for 2 pipe diameter distance from the insulating flange in both directions. Apply and cure coating in accordance with the manufacturer's recommendations. Do not apply coating where it will interfere with operation of pipeline valves or other pipeline assemblies.

3.7 TESTS AND INSPECTION

- A. Test Equipment: Before construction begins, obtain the test equipment necessary for electrical continuity testing, and the following equipment:

SECTION 16640 – CATHODIC PROTECTION SYSTEM

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. Electrical Continuity Testing:

1. The CONTRACTOR shall measure the linear resistance of sections of pipe that contains in-line valves or fitting and/or non-welded pipe joints. All testing shall be done by the CORROSION ENGINEER in the presence of the RESIDENT ENGINEER.
2. Resistance shall be measured by the linear resistance method. A direct current shall be impressed from one end of the test section to the other (test station to test station) using DC power supply (battery). A voltage drop is measured for several current levels. The resistance (R) is calculated using the equation $R = dV/I$, where dV is the voltage drop and I is the current. The resistance shall be calculated for three or four different current levels.
3. Acceptance is reasonable comparison of the measured resistance with the calculated or theoretical resistance. The measured resistance shall not exceed the theoretical resistance by more than 130%. The CONTRACTOR shall submit calculations of the theoretical resistance and the measured resistance for each section of pipe tested.
4. If discontinuity or high resistance is found between sections of pipe tested, it is the CONTRACTOR's responsibility to locate, excavate, and repair all bonds that are found to be discontinuous. Continuity tests shall be repeated after repairs are made.

C. Insulated Joint Testing:

1. Insulating flanges shall be inspected and tested by the CONTRACTOR, in the presence of the RESIDENT ENGINEER. Buried insulators must be tested and approved prior to application of wax tape and backfilling.
2. The assembled flange shall be tested with a Gas Electronics Model 601 Insulator Checker specifically designed for the testing of insulating flanges. The testing shall be done by the CORROSION ENGINEER in accordance with NACE RP0286-97.

SECTION 16640 – CATHODIC PROTECTION SYSTEM

3. The installation of the insulating flange kit shall be shall be considered complete when the testing device indicates no shorts or partial shorts are present. Any deflection of the meter, no matter how small, indicates a short. The CONTRACTOR shall provide assistance in finding any and all shorts or shorted bolts. All disassembly and re-assembly necessary for acceptance shall be done at the CONTRACTOR's expense.
- D. Cathodic Protection Performance Testing::
1. The cathodic protection system shall be activated and tested by the CORROSION ENGINEER in the presence of the RESIDENT ENGINEER and the City's CORROSION ENGINEER. Upon completion of the performance testing, the CONTRACTOR shall adjust the level of protection in per direction from the City's CORROSION ENGINEER.
 2. Achievement of cathodic protection shall be determined by a pipe-to-soil potential survey with potential measurements made at all test stations and at other locations as the RESIDENT ENGINEER determines to be necessary. Potential survey data shall include both native potentials (before cathodic protection) and instant-off potentials upon activation of the system
 3. Additional Testing: The CONTRACTOR shall perform additional measurements as required to locate shorts or other cathodic protection system deficiencies.

**** END OF SECTION ****

SECTION 16950 – ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall test, commission and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the CONTRACT DOCUMENTS.

1.2 GENERAL

- A. The Work of this Section includes furnishing the labor, equipment and power required to support the testing in other Divisions of these Specifications. Electrical testing herein, and functional testing of all power and controls not tested under Section 13300 - Instrumentation and Control shall be completed before commencement of the 7-day test required in Section 01660 – Facility Start-Up and Operator Training. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers.

1.3 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01300 Submittals
 - 2. Section 01680 Physical Checkout, Shop, Field and Functional Testing
 - 3. Section 01660 Facility Start-Up and Operator Training
 - 4. Section 13300 Instrumentation and Control
 - 5. Section 16050 Basic Electrical Materials and Methods
 - 6. Section 16431 Short Circuit and Coordination Report

1.4 CODES

- A. The Work of this Section shall comply with the current editions of the National Electrical Code as adopted by the City of San Diego.

1.5 STANDARDS

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

SECTION 16950 – ELECTRICAL TESTS

- | | | |
|----|------|---|
| 1. | NETA | National Electrical Testing Association |
| 2. | ICEA | Insulated Cable Engineers Association |

1.6 TESTING

A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching, including remote control, as indicated. Circuitry is in accordance with panel schedules. Lighting fixtures located to minimize obstruction of illumination by mechanical equipment or building structural elements.
2. Power Instrumentation: Demonstrate that voltmeter and ammeter switches are functional. Demonstrate that meters are within catalog accuracy as installed with specific reference to kilowatt meters.
3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known, and reasonable, current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20% of phase current. Current injection is not required of circuit 400 A or less.
5. Cable Testing: 480-V circuits shall be tested for insulation resistance with a 1000-V megohm meter. Testing shall be done after the 480-V equipment is terminated. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test. Test results shall be submitted and shall state equipment used and time of test. Cable testing and report submittal shall be performed by an organization sanctioned by the Manufacturer of the cable to be tested. Testing shall verify the quality of cable terminations. Test results for medium and high voltage cable shall be submitted 30 days prior to the time schedule for equipment energization.

SECTION 16950 – ELECTRICAL TESTS

6. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.
 7. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
 - a. Visual and physical check of cables, busswork, circuit breakers, transformers, and connections associated with all new and modified equipment.
 - b. Setting of protective relays in conformance with results of the Short Circuit Study and testing of relays to assure that relays will trip at the current value and time required by the Study.
 - c. Circuit breakers with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker Manufacturer. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified by the test or and transmitted to the RESIDENT ENGINEER.
 8. Complete ground testing of all grounding electrodes prior to operating the equipment. (See Section 16050 - Basic Electrical Materials and Methods. Use a three-point ground test.)
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the RESIDENT ENGINEER and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
- C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the CONTRACT DOCUMENTS. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, and proper speed control.

SECTION 16950 – ELECTRICAL TESTS

- D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve Manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.
- E. Provide ground resistance tests in the presence of the RESIDENT ENGINEER and submit results. Use a ground resistance meggar "Earth" tester with a maximum of 0-50 scale. Use the full of potential method or the three terminal method as described by Biddle or Neta.
- F. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, and air compressors.
- G. General: Carry out tests for individual items of materials and equipment indicated in other Sections.

1.7 COMMISSIONING

- A. Commissioning during the 7-day test as specified in Section 01680 - Physical Checkout, Shop, Field and Functional Testing, shall not be attempted until all subsystems have been found to operate satisfactorily; commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters will be considered only upon receipt of a written request.
- B. The motor current tabulation required by Section 16431 - Electrical Systems Analysis, shall reflect the values occurring during commissioning. The indications of all switchboard ammeters and kilowatt meters shall be recorded every half-hour during commissioning.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

**** END OF SECTION ****

SUPPLEMENTARY SPECIAL PROVISIONS
APPENDICES

APPENDIX A
FINAL MITIGATED NEGATIVE DECLARATION



Advance Planning &
Engineering Division
(619) 446-5460

**FINAL
MITIGATED NEGATIVE DECLARATION**

Project No. 327584
SCH No. N/A

SUBJECT: LA JOLLA COUNTRY RESERVOIR AND PUMP STATION PROJECT. SITE DEVELOPMENT PERMIT AND COASTAL DEVELOPMENT PERMIT to construct a new 0.88 million gallon (MG) concrete rectangular reservoir with vertical walls almost entirely within the existing footprint of the existing 0.50 MG reservoir bottom and overflow elevations. The reservoir would be approximately 15-foot-tall 1.5 feet above finished grade, 56 feet wide, and 139 feet long with a bottom elevation of approximately 709.9 feet above mean sea level (amsl). The pump station would also be replaced, and three new pumps with a total capacity of 2,125 gallons per minute would be installed along with a new pressure relief valve, new valve vault, bypass lines, reservoir inlet/outlet piping and bypass, security/fencing, electrical upgrades, new landscaping and a permanent drain system.

Update 12/18/2014:

Minor revisions have been made to the Final Mitigated Negative Declaration (MND) which are shown in a ~~strikeout~~ and underlined format. In accordance with California Environmental Quality Act (CEQA) Section 15073.5 (c)(4), the addition of new information that clarifies, amplifies, or makes insignificant modification does not require recirculation as there are no new impacts and no new mitigation identified. An environmental document need only be recirculated when there is identification of new significant environmental impact or the addition of a new mitigation measure required to avoid a significant environmental impact.

- I. PROJECT DESCRIPTION: See attached Initial Study.
- II. ENVIRONMENTAL SETTING: See attached Initial Study.
- III. DETERMINATION:

The City of San Diego conducted an Initial Study which determined that the proposed project could have a significant environmental effect in the following areas(s): **PALEONTOLOGY**. Subsequent revisions in the project proposal create the specific mitigation identified in Section V of this Mitigated Negative Declaration. The project as revised now avoids or mitigates the potentially significant environmental effects previously identified, and the preparation of an Environmental Impact Report will not be required.

- IV. DOCUMENTATION:

The attached Initial Study documents the reasons to support the above Determination.

V. MITIGATION, MONITORING AND REPORTING PROGRAM:

A. GENERAL REQUIREMENTS – PART I

Plan Check Phase (prior to permit issuance)

1. Prior to issuance of any construction permits, such as Demolition, Grading or Building, or beginning any construction related activity on-site, the Development Services Department (DSD) Director's Environmental Designee (ED) shall review and approve all Construction Documents (CD), (plans, specification, details, etc.) to ensure the MMRP requirements are incorporated into the design.
2. In addition, the ED shall verify that the MMRP Conditions/Notes that apply ONLY to the construction phases of the project(s) are included VERBATIM, under the heading, "ENVIRONMENTAL/MITIGATION REQUIREMENTS."
3. These notes must be shown within the first three (3) sheets of the construction documents in the format specified for engineering construction document templates as shown on the City website:

<http://www.sandiego.gov/development-services/industry/standtemp.shtml>

4. The **TITLE INDEX SHEET** must also show on which pages the "Environmental/Mitigation Requirements" notes are provided.

B. GENERAL REQUIREMENTS – PART II

Post Plan Check (After permit issuance/Prior to start of construction)

1. **PRE CONSTRUCTION MEETING IS REQUIRED TEN (10) WORKING DAYS PRIOR TO BEGINNING ANY WORK ON THIS PROJECT.** The PERMIT HOLDER/OWNER is responsible to arrange and perform this meeting by contacting the CITY RESIDENT ENGINEER (RE) of the Field Engineering Division and City staff from MITIGATION MONITORING COORDINATION (MMC). Attendees must also include the Permit holder's Representative(s), Job Site Superintendent and the following consultants:

Paleontological Consultants/Monitor

Note: Failure of all responsible Permit Holder's representatives and consultants to attend shall require an additional meeting with all parties present.

CONTACT INFORMATION:

- a) The PRIMARY POINT OF CONTACT is the RE at the **Field Engineering Division (858) 627-3200**
 - b) For Clarification of ENVIRONMENTAL REQUIREMENTS, it is also required to call RE and MMC at **(858)627-3360**
2. **MMRP COMPLIANCE:** This Project No. 327584 shall conform to the mitigation requirements contained in the associated Construction Plans and implemented to the satisfaction of the DSD's Environmental Designee (MMC) and the City Engineer (RE). The requirements may not be reduced or changed but may be annotated (i.e. to explain when and how compliance is being met and location of verifying proof, etc.).

Additional clarifying information may also be added to other relevant plan sheets and/or specifications as appropriate (i.e., specific locations, times of monitoring, methodology, etc)

Note: Permit Holder’s Representatives must alert RE and MMC if there are any discrepancies in the plans or notes, or any changes due to field conditions. All conflicts must be approved by RE and MMC BEFORE the work is performed.

3. OTHER AGENCY REQUIREMENTS: Evidence of compliance with all other agency requirements or permits shall be submitted to the RE and MMC for review and acceptance prior to the beginning of work or within one week of the Permit Holder obtaining documentation of those permits or requirements. Evidence shall include copies of permits, letters of resolution or other documentation issued by the responsible agency.

None required for this project

4. MONITORING EXHIBITS. All consultants are required to submit, to RE and MMC, a monitoring exhibit on a 11x17 reduction of the appropriate construction plan, such as site plan, grading, landscape, etc., marked to clearly show the specific areas including the **LIMIT OF WORK**, scope of that discipline’s work, and notes indicating when in the construction schedule that work will be performed. When necessary for clarification, a detailed methodology of how the work will be performed shall be included.

5. OTHER SUBMITTALS AND INSPECTIONS: The Permit Holder/Owner’s representative shall submit all required documentation, verification letters, and requests for all associated inspections to the RE and MMC for approval per the following schedule:

Document Submittal/Inspection Checklist

[List all and only project specific required verification documents and related inspections table below]

Issue Area	Document submittal	Assoc Inspection/Approvals/Notes
General	Consultant Qualification Letters	Prior to Pre-construction Meeting
General	Consultant Const. Monitoring Exhibits	Prior to or at Pre-Construction Mtg
Paleontology	Paleontology Reports	Paleontology site observation
Final MMRP	Final monitoring reports	Final MMRP inspection

C. SPECIFIC MMRP ISSUE AREA CONDITIONS/REQUIREMENTS

PALEONTOLOGICAL RESOURCES

I. Prior to Permit Issuance or Bid Opening/Bid Award

- A. Entitlements Plan Check
 - 1. Prior to permit issuance or Bid Opening/Bid Award, whichever is applicable, ADD Environmental designee shall verify that the requirements for Paleontological Monitoring have been noted on the appropriate construction documents.
- B. Letters of Qualification have been submitted to ADD
 - 1. Prior to Bid Award, the applicant shall submit a letter of verification to MMC identifying the PI for the project and the names of all persons involved in the paleontological monitoring program.
 - 2. MMC will provide a letter to the applicant confirming the qualifications of the PI and all persons involved in the paleontological monitoring of the project.
 - 3. Prior to the start of work, the applicant must obtain approval from MMC for any personnel changes associated with the monitoring program.

II. Prior to Start of Construction

- A. Verification of Records Search
 - 1. The PI shall provide verification to MMC that a site specific records search has been completed. Verification includes, but is not limited to a copy of a confirmation letter from San Diego Natural History Museum, other institution, or, if the search was in-house, a letter of verification from the PI stating that the search was completed.
 - 2. The letter shall introduce any pertinent information concerning expectations and probabilities of discovery during trenching and/or grading activities.
- B. PI Shall Attend Pre-con Meetings
 - 1. Prior to beginning any work that requires monitoring; the Applicant shall arrange a Pre-con Meeting that shall include the PI, CM and/or Grading Contractor, RE, BI, if appropriate, and MMC. The qualified Paleontologist shall attend any grading/excavation related Pre-con Meetings to make comments and/or suggestions concerning the Paleontological Monitoring program with the Construction Manager and/or Grading Contractor.
 - a. If the PI is unable to attend the Pre-con Meeting, the Applicant shall schedule a focused Pre-con Meeting with MMC, the PI, RE, CM or BI, if appropriate, prior to the start of any work that requires monitoring.
 - 2. Identify Areas to be Monitored
 - a. Prior to the start of any work that requires monitoring, the PI shall submit a Paleontological Monitoring Exhibit (PME) based on the appropriate construction documents (reduced to 11x17) to MMC for approval identifying the areas to be monitored including the delineation of grading/excavation limits.
 - b. The PME shall be based on the results of a site specific records search as well as information regarding existing known soil conditions (native or formation).
 - c. MMC shall notify the PI that the PME has been approved.
 - 3. When Monitoring Will Occur
 - a. Prior to the start of any work, the PI shall also submit a construction schedule to MMC through the RE indicating when and where monitoring will occur.
 - b. The PI may submit a detailed letter to MMC prior to the start of work or during construction requesting a modification to the monitoring program. This request shall be based on relevant information such as review of final construction documents which indicate conditions such as depth of excavation and/or site graded to bedrock, presence or absence of fossil resources, etc., which may reduce or increase the potential for resources to be present.

III. During Construction

A. Monitor Shall be Present During Grading/Excavation/Trenching

1. The monitors shall be present full-time during grading/excavation/trenching activities identified on the PME that could result in impacts to formations with moderate resource sensitivity (Lindavista, Scripps, and Ardath Shale formations). **The CM is responsible for notifying the RE, PI, and MMC of changes to any construction activities such as in the case of a potential safety concern within the area being monitored. In certain circumstances OSHA safety requirements may necessitate modification of the PME.**
2. The PI may submit a detailed letter to the CM and/or RE for concurrence and forwarding to MMC during construction requesting a modification to the monitoring program when a field condition such as trenching activities that do not encounter formational soils as previously assumed, and/or when unique/unusual fossils are encountered, which may reduce or increase the potential for resources to be present.
3. The monitor shall document field activity via the CSV. The CSV's shall be faxed by the CM to the RE the first day of monitoring, the last day of monitoring, monthly (**Notification of Monitoring Completion**), and in the case of ANY discoveries. The RE shall forward copies to MMC.

B. Discovery Notification Process

1. In the event of a discovery, the Paleontological Monitor shall direct the contractor to temporarily divert trenching activities in the area of discovery and immediately notify the RE or BI, as appropriate.
2. The Monitor shall immediately notify the PI (unless Monitor is the PI) of the discovery.
3. The PI shall immediately notify MMC by phone of the discovery, and shall also submit written documentation to MMC within 24 hours by fax or email with photos of the resource in context, if possible.

C. Determination of Significance

1. The PI shall evaluate the significance of the resource.
 - a. The PI shall immediately notify MMC by phone to discuss significance determination and shall also submit a letter to MMC indicating whether additional mitigation is required. The determination of significance for fossil discoveries shall be at the discretion of the PI.
 - b. If the resource is significant, the PI shall submit a Paleontological Recovery Program (PRP) and obtain written approval from the MMC. Impacts to significant resources must be mitigated before ground disturbing activities in the area of discovery will be allowed to resume.
 - c. If resource is not significant (e.g., small pieces of broken common shell fragments or other scattered common fossils), the PI shall notify the RE, or BI as appropriate, that a non-significant discovery has been made. The Paleontologist shall continue to monitor the area without notification to the MMC unless a significant resource is encountered.

IV. Night and/or Weekend Work

A. If night and/or weekend work is included in the contract

1. When night and/or weekend work is included in the contract package, the extent and timing shall be presented and discussed at the Pre-con meeting.
2. The following procedures shall be followed.

- a. No Discoveries
In the event that no discoveries were encountered during night and/or weekend work, the PI shall record the information on the CSVR and submit to MMC via fax by 8AM of the next business day.
 - b. Discoveries
All discoveries shall be processed and documented using the existing procedures detailed in Sections III - During Construction.
 - c. Potentially Significant Discoveries
If the PI determines that a potentially significant discovery has been made, the procedures detailed under Section III - During Construction shall be followed.
 - d. The PI shall immediately contact the RE and MMC, or by 8AM of the next business day to report and discuss the findings as indicated in Section III-B, unless other specific arrangements have been made.
- B. If night and/or weekend work becomes necessary during the course of construction
 - 1. The CM shall notify the RE, or BI, as appropriate, a minimum of 24 hours before the work is to begin.
 - 2. The RE, or BI, as appropriate, shall notify MMC immediately.
 - C. All other procedures described above shall apply, as appropriate.

V. Post Construction

- A. Submittal of Draft Monitoring Report
 - 1. The PI shall submit two copies of the Draft Monitoring Report (even if negative), prepared in accordance with the Paleontological Guidelines which describes the results, analysis, and conclusions of all phases of the Paleontological Monitoring Program (with appropriate graphics) to the MMC for review and approval within 90 days following the completion of monitoring,
 - a. For significant paleontological resources encountered during monitoring, the Paleontological Recovery Program shall be included in the Draft Monitoring Reports.
 - b. Recording Sites with the San Diego Natural History Museum
The PI shall be responsible for recording (on the appropriate State of California Department of Park and Recreation forms-DPR 523 A/B) any significant or potentially significant resources encountered during the Paleontological Monitoring Program in accordance with the City's Paleontological Guidelines, and submittal of such forms to the San Diego Natural History Museum with the Final Monitoring Report.
 - 2. MMC shall return the Draft Monitoring Report to the PI via the RE for revision or, for preparation of the Final Report.
 - 3. The PI shall submit revised Draft Monitoring Report to MMC via the RE for approval.
 - 4. MMC shall provide written verification to the PI of the approved report.
 - 5. MMC shall notify the RE or BI, as appropriate, of receipt of all Draft Monitoring Report submittals and approvals.
- B. Handling of Fossil Remains
 - 1. The PI shall be responsible for ensuring that all fossil remains collected are cleaned and catalogued
 - 2. The PI shall be responsible for ensuring that all fossil remains are analyzed to identify function and chronology as they relate to the geologic history of the area; that faunal

material is identified as to species; and that specialty studies are completed, as appropriate.

C. Curation of fossil remains: Deed of Gift and Acceptance Verification

1. The PI shall be responsible for ensuring that all fossil remains associated with the monitoring for this project are permanently curated with an appropriate institution.
2. The PI shall include the Acceptance Verification from the curation institution in the Final Monitoring Report submitted to the RE or BI and MMC.

D. Final Monitoring Report(s)

1. The PI shall submit one copy of the approved Final Monitoring Report to the RE or BI as appropriate, and one copy to MMC (even if negative), within 90 days after notification from MMC of the approved report.
2. The RE shall, in no case, issue the Notice of Completion until receiving a copy of the approved Final Monitoring Report from MMC which includes the Acceptance Verification from the curation institution.

The above mitigation monitoring and reporting program will require additional fees and/or deposits to be collected prior to the issuance of building permits, certificates of occupancy and/or final maps to ensure the successful completion of the monitoring program.

VI. PUBLIC REVIEW DISTRIBUTION:

Draft copies or notice of this Mitigated Negative Declaration were distributed to:

City of San Diego

Mayor's Office

Councilmember Sherri Lightner

City Attorney

Shannon Thomas

Development Services Department

Rebecca Malone

Myra Herrmann

Angela Nazareno

Public Works Department

David Manela

Darren Genova

La Jolla/Riford Branch Library (81L)

Library Department – Government Documents (81)

Real Estate Assets Dept. (85)

Others

La Jolla Village News (271)

La Jolla Shores Association (272)

La Jolla Town Council (273)

La Jolla Historical Society (274)

La Jolla Community Planning Association (275)

La Jolla Light (280)


San Diego Natural History Museum (166)

Patricia K. Miller (283)

VII. RESULTS OF PUBLIC REVIEW:

- (X) No comments were received during the public input period.
- () Comments were received but did not address the draft Mitigated Negative Declaration finding or the accuracy/completeness of the Initial Study. No response is necessary. The letters are attached.
- () Comments addressing the findings of the draft Mitigated Negative Declaration and/or accuracy or completeness of the Initial Study were received during the public input period. The letters and responses follow.

Copies of the draft Mitigated Negative Declaration, the Mitigation, Monitoring and Reporting Program and any Initial Study material are available in the office of the Development Services Department for review, or for purchase at the cost of reproduction.


Myra Herrmann, Senior Planner
Planning Department

November 5, 2014
Date of Draft Report

December 22, 2014
Date of Final Report

Analyst: **Rebecca Malone**

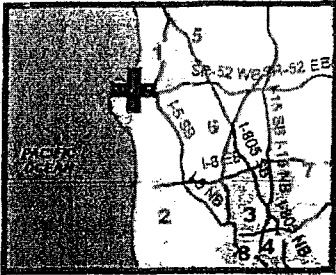
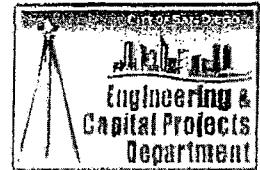
Attachments: Figure 1: Location Map
Initial Study

Revised 120710mjh

Location Map
**La Jolla Country Club
 Reservoir & Pump Station**

Senior Engineer
 Hossein Azar
 619-533-4102

PROJECT MANAGER
 David Manela
 619-533-6682



Legend

● Project Locations



Location Map

La Jolla Country Club Reservoir and Pump Station/Project No. 327584
 City of San Diego – Development Services Department

FIGURE

No. 1

INITIAL STUDY CHECKLIST

1. Project title/Project number: La Jolla Country Club Reservoir & Pump Station/Project No. 327584
2. Lead agency name and address: City of San Diego, Development Services Department, 1222 First Avenue, MS 501, San Diego, CA 92101-4101
3. Contact person and phone number: Rebecca Malone, Associate Planner, 619-446-5371
4. Project location: 7269 Encelia Drive, La Jolla, CA 92037. The APN is 352-232-12-00.
5. Project Applicant/Sponsor's name and address: City of San Diego Public Works /Engineering & Capital Project Department, 525 B St., Suite 750, MS 908A, San Diego, CA 92101. Contact: David Manela, Project Manager, 619-533-6682.
6. General/Community Plan Designation: The La Jolla Community Plan designates the parcel Very Low Residential (0-5 DU/AC).

7. Zoning: RS-1-2, RS-1-4 (Residential)

8. Description of project (Describe the whole action involved, including but not limited to, later phases of the project, and any secondary, support, or off-site features necessary for its implementation.):

The La Jolla County Club Reservoir and Pump Station project is part of the City of San Diego's Public Utilities Department Capital Improvement Program. The La Jolla Country Club Reservoir and Pump Station has reached the end of its useful lifespan and needs to be replaced and upgraded to meet current and future demands. The existing reservoir is a 0.5 million gallon (MG), below grade concrete reservoir built in 1927 with a wooden frame structure supporting a corrugated metal roof. This reservoir, along with the Soledad Reservoir, serves the 725 pressure zone in the La Jolla community. The existing pump station was built in 1985 with two pumps and a total capacity of 2.3 million gallons per day (MGD).

The La Jolla County Club Reservoir and Pump Station project is located at 1748 1/3 Upper Hillside Drive in the community of La Jolla within Council District 1. This project would construct a new 0.88 MG concrete rectangular reservoir with vertical walls almost entirely within the existing footprint of the existing reservoir bottom and overflow elevations. The reservoir would be approximately 45 feet-tall, 1.5 feet above finished grade, 56 feet wide, and 139 feet long with a bottom elevation of approximately 709.9 feet above mean sea level (amsl). The pump station would also be replaced and three new pumps with a total capacity of 2,125 gallons per minute will be installed along with a new pressure relief valve, new valve vault, bypass lines, reservoir inlet/outlet piping and bypass, security/fencing, electrical upgrades, new landscaping and a permanent drain system. The proposed reservoir would have a smooth natural colored concrete finish.

The proposed pump station will be located in the same general location as the existing pump station and the height will remain substantially the same. The building will be constructed of split-faced masonry block with a natural color. The roof material for the pump station will be a Spanish tile roof to blend with the surrounding homes. Landscaping removed from the project site will be replaced after construction of the project to provide screening of the building.

Construction staging would occur on-site on the existing access road to the reservoir. Should additional space be necessary, construction staging would occur on the access road and cul-de-sac for the La Jolla View Reservoir on Encelia Drive.

The project will require both a Coastal Development Permit and a Site Development Permit.

9. Surrounding land uses and setting: Briefly describe the project's surroundings:

Surrounding land uses are Residential and Open Space. The reservoir and pump station are located on a hill with open space to the north and residential homes on all other sides of the site. The project is located within the City's Non-appealable Coastal Overlay Zone. The project is not located within or adjacent to the City of San Diego's Multi-Habitat Planning Area (MHPA). Existing landscaping on-site consists of predominately ornamental vegetation. This project will avoid impacts to the open space area located outside of the fence line for the facility.

10. Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.): None.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

- | | | |
|---|--|---|
| <input type="checkbox"/> Aesthetics | <input type="checkbox"/> Greenhouse Gas Emissions | <input type="checkbox"/> Population/Housing |
| <input type="checkbox"/> Agriculture and Forestry Resources | <input type="checkbox"/> Hazards & Hazardous Materials | <input type="checkbox"/> Public Services |
| <input type="checkbox"/> Air Quality | <input type="checkbox"/> Hydrology/Water Quality | <input type="checkbox"/> Recreation |
| <input type="checkbox"/> Biological Resources | <input type="checkbox"/> Land Use/Planning | <input type="checkbox"/> Transportation/Traffic |
| <input checked="" type="checkbox"/> Cultural Resources | <input type="checkbox"/> Mineral Resources | <input type="checkbox"/> Utilities/Service System |
| <input type="checkbox"/> Geology/Soils | <input type="checkbox"/> Noise | <input checked="" type="checkbox"/> Mandatory Findings Significance |

DETERMINATION: (To be completed by Lead Agency)

On the basis of this initial evaluation:

- The proposed project **COULD NOT** have a significant effect on the environment, and a **NEGATIVE DECLARATION** will be prepared.
- Although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A **MITIGATED NEGATIVE DECLARATION** will be prepared.
- The proposed project **MAY** have a significant effect on the environment, and an **ENVIRONMENTAL IMPACT REPORT** is required.
- The proposed project **MAY** have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect (a) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (b) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An **ENVIRONMENTAL IMPACT REPORT** is required.
- Although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or (MITIGATED) **NEGATIVE DECLARATION** pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or (MITIGATED) **NEGATIVE DECLARATION**, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

EVALUATION OF ENVIRONMENTAL IMPACTS:

- 1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project specific factors

as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis.)

- 2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
- 3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.
- 4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses", as described in (5) below, may be cross-referenced).
- 5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or (mitigated) negative declaration. *Section 15063(c)(3)(D)*. In this case, a brief discussion should identify the following:
 - a. Earlier Analysis Used. Identify and state where they are available for review.
 - b. Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
 - c. Mitigation Measures. For effects that are "Less Than Significant With Mitigation Measures Incorporated", describe the mitigation measures that were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.
- 6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
- 7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.
- 8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.
- 9) The explanation of each issue should identify:
 - a. The significance criteria or threshold, if any, used to evaluate each question; and
 - b. The mitigation measure identified, if any, to reduce the impact to less than significant.

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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I) AESTHETICS – Would the project:

- a) Have a substantial adverse effect on a scenic vista?

The project would not impact any designated scenic vista identified in the La Jolla Community Plan. The project site is located at a high point on a hill and is set back from the street by approximately 180 feet. The proposed reservoir and pump station would be approximately the same size and in the same location as the existing facility. The proposed reservoir's height would not be increased above the existing reservoir's height.

The proposed pump station would be approximately the same height as the existing structure, (approximately 1.5 feet above finished grade). In addition, any on-site ornamental vegetation removed to accommodate installation of the reservoir, pump station, and appurtenances, would be replaced to provide screening of the facility from adjacent residential properties.

- b) Substantially damage scenic resources, including but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?

The project is not located within or adjacent to a state scenic highway. It is located within a residential area in the community of La Jolla. In addition, a Historic Resource Technical Report, dated April 25, 2013, and prepared by IS Architecture was submitted to the Historic Resources Board staff, who concluded that the property is not historically significant and that the pump station building and reservoir are not eligible for designation.

- c) Substantially degrade the existing visual character or quality of the site and its surroundings?

The proposed project would not degrade the visual character or quality of the site. The project proposes to replace an existing 464 sq. ft. pump station with a new 768 sq. ft. pump station and replace an existing approximately 7,500 sq. ft. reservoir with a new 7,784 sq. ft. reservoir. Both the new reservoir and pump station will occupy approximately the same footprint as the existing reservoir and pump station. Both would also be approximately the same size and height as the existing facilities. The pump station would be constructed of split-face masonry block with a natural color. The proposed roof material proposed is Spanish tile to blend with the existing tile roofs on the surrounding residences. In addition, the proposed reservoir is located approximately 180 feet from the site's entrance off of Upper Hillside Drive and would not be visible from the roadway. Any ornamental landscaping removed to accommodate construction will be replaced to provide screening of the facility. As such, the project will not result in a substantial degradation of the site or its surroundings.

- d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?

The project proposes the replacement of the existing reservoir and pump station and associated appurtenances. Both the reservoir and the pump station will be constructed in virtually the same location as the existing reservoir and pump station. The materials used to construct the reservoir

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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and pump station will blend with the existing surroundings. These improvements are not sources of substantial light or glare and any removal of landscaping will be replaced; therefore the project will not adversely affect the day or nighttime views in the area.

II. AGRICULTURAL AND FOREST RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. – Would the project:

- a) Converts Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?

The project site is not classified as farmland by the Farmland Mapping and Monitoring Program (FMMP). The surrounding land uses consist of very low density residential and open space. Therefore, the project would not result in the conversion of farmland to non-agricultural uses. No impact would occur.

- b) Conflict with existing zoning for agricultural use, or a Williamson Act Contract?

The project site is covered by a Williamson Act Contract. The project site is zoned for residential uses and surrounding land uses consist of very low density residential and open space. Therefore, the project would not conflict with existing zoning for agricultural use or a Williamson Act Contract. No impact would occur.

- c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 1220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?

The project site is zoned RS-1-2 and RS-1-4 (Residential). Surrounding land uses are residential and open space. There is no proposed rezoning of the property; therefore, the project would not impact or conflict with forest land, timberland, or Timberland Production zoned land. No impact would occur.

- d) Result in the loss of forest land or conversion of forest land to non-

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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forest use?

The project site is zoned RS-1-2 and RS-1-4 (Residential). Surrounding land uses are residential and open space. There is no proposed rezoning of the property; therefore, the project would not result in the loss of forest land or conversion of forest land to non-forest use. No impact would occur.

- e) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?

The project site is zoned RS-1-2 and RS-1-4 (Residential). Surrounding land uses are residential and open space. There is no proposed rezoning of the property; therefore, there would be no conversion of Farmland to non-agricultural use or forest land to non-forest use. No impact would occur.

III. AIR QUALITY – Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the following determinations – Would the project:

- a) Conflict with or obstruct implementation of the applicable air quality plan?

The project would not generate a substantial amount of emissions as a result of the proposed use (e.g., vehicle miles traveled, etc.). The project proposes to replace an existing reservoir, pump station, and piping (appurtenances) which would have negligible emissions during operations. An increase in emissions would occur during construction; however, this increase would be temporary and minimal and would not conflict with implementation of the applicable air quality plan. Impacts would be less than significant.

- b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?

The project would not generate a substantial amount of emissions as a result of the proposed use. The project would replace an existing reservoir, pump station, and piping (appurtenances), which would have negligible emissions during operations. An increase in emissions would occur during construction; however, this increase would be temporary and minimal. This increase in emissions would not violate any air quality standard or contribute substantially to any air quality violations. Impacts would be less than significant.

- c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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(including releasing emissions which exceed quantitative thresholds for ozone precursors)?

Construction operations could temporarily increase the emissions of dust and other pollutants associated with the use of construction equipment; however, these emissions would be minimized by the implementation of Best Management Practices (BMPs). The scope of the project would not increase the number of Vehicle Miles Traveled (VMT) since there is already an existing reservoir and pump station at this location. Emissions associated with operation of the facility are related to the use of energy to power pumps. Construction worker VMT's to provide maintenance and inspection of the pump station would also create emissions; however, maintenance and inspection are infrequent and the emissions created by VMTs for these purposes are negligible. Therefore, the project would not result in a cumulatively considerable net increase of any criteria pollutant for which the project is non-attainment in the region under applicable federal or state ambient air quality standards. Impacts would be less than significant.

- d) Create objectionable odors affecting a substantial number of people?

Operation of construction equipment and vehicles could generate odors associated with fuel combustion. However, these odors would dissipate into the atmosphere upon release. Therefore, the project would not create substantial amounts of objectionable odors affecting a substantial number of people. No Impact would result.

IV. BIOLOGICAL RESOURCES – Would the project:

- a) Have substantial adverse effects, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?

The project is located entirely within a developed site. The project site is located outside of the Multi-Habitat Planning Area (MHPA) and would not affect sensitive biological resources as defined in the MSCP Subarea Plan or the City's Biological Guidelines. A biological assessment, dated February 20, 2014, concluded that no sensitive biological resources will be disturbed by the construction of the project as there would be no impacts to sensitive vegetation or direct impacts to any areas that could support nesting habitat. The project site does contain several large eucalyptus trees that could support raptors and the site is adjacent to potential songbird nesting habitat. To avoid any impacts to these species, work would occur outside the general breeding season from February 1 to September 15 to the greatest extent possible. If this is not possible, then a pre-construction nesting survey by a qualified biologist will be performed within 10 days prior to vegetation impacts in order to comply with the Migratory Bird Treaty Act. Impacts would be less than significant.

- b) Have a substantial adverse effect on any riparian habitat or other

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?

The project site is located outside of the Multi-Habitat Planning Area (MHPA) and would not affect sensitive biological resources as defined in the MSCP Subarea Plan or the City's Biological Guidelines. A biological assessment for the project area concluded that no sensitive biological resources would be disturbed by the construction of the project. The site does not contain riparian or other habitat identified in a local, regional or state plan or policy. The project would not have a substantial adverse effect on any riparian or other habitat. No impacts would result.

- c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including but not limited to marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?

The project site is located outside of the Multi-Habitat Planning Area (MHPA) and would not affect sensitive biological resources as defined in the MSCP Subarea Plan or the City's Biological Guidelines. The project's biological assessment concluded that no sensitive biological resources will be disturbed by the construction of the project. The site does not contain wetlands, riparian or other habitat identified in a local, regional or state plan or policy. The project would not have a substantial adverse effect on any riparian or other habitat. No impact would result.

- d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?

Due to the relatively small scale and location of the proposed project, the project would not significantly impact a wildlife corridor or alter the movement of wildlife and thus would not be considered significant under CEQA. The project is currently fenced off from the adjacent open space area and the existing fence line on the north would be maintained to separate the facility from any adjacent Coastal sage scrub/chaparral areas. Therefore, no additional disruption to the movement of any fish or wildlife species or to wildlife nursery sites would occur. No impact would result.

- e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?

The project would remove approximately eight existing ornamental trees on site, however, the trees are not considered a biological resource and they are not protected by a tree preservation policy or ordinance. Existing trees to remain would be protected in place and incorporated into the proposed landscape site design. The project would not conflict with any local policies or

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
ordinances protecting biological resources. No impact would result.				

- f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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The project site is located outside of the Multi-Habitat Planning Area (MHPA) and would not affect sensitive biological resources as defined in the MSCP Subarea Plan or the City's Biological Guidelines. A biological assessment prepared for the proposed project concluded that no impacts to environmentally sensitive lands would occur from the construction of the project because the project would only impact urban/developed and disturbed habitat and because work limits will be bounded by the existing fence line on the north to separate the Coastal sage/chaparral from the project area. However, because the project would be located in and adjacent to songbird and raptor nesting habitat, it is recommended that work occur outside the general breeding season from February 1 to September 15. If this is not possible, then a pre-construction nest survey by a qualified biologist would be performed within 10 days prior to vegetation impacts in order to comply with the Migratory Bird Treaty Act. Impacts would be less than significant.

V. CULTURAL RESOURCES – Would the project:

- a) Cause a substantial adverse change in the significance of an historical resource as defined in §15064.5?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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The existing reservoir was constructed in 1927 and the existing pump station was constructed in 1985. No archaeological resources are mapped within or adjacent to the site. Therefore, the project would not cause a substantial adverse change in the significance of a historical resource, would not result in a significant impact to historical resources, and would not result in a significant adverse impact to archaeological resources. In addition, a Historic Resource Technical Report, dated April 25, 2013, and prepared by IS Architecture was submitted to the Historic Resources Board staff, who concluded that the reservoir is not historically significant and not eligible for designation. Impacts would be less than significant.

- b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
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The new reservoir, pump station and appurtenances would be constructed in virtually the same location as and would be approximately the same size as the existing facility; therefore, the project would not cause a substantial change in the significance of an archaeological resource. No impact would result.

- c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?
- | | | | |
|--------------------------|-------------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
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The project would include excavation up to 20 to 25 feet below grade in some areas. Fossil

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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resources within the Mt. Soledad Formation, Cabrillo Formation and Linda Vista Formation could be impacted during construction related activities. All three formations are identified as "Moderate" sensitivity in the City's Paleontological Guidelines. According to the City's CEQA Significance Thresholds, excavation of 2,000 CY and at depths greater than 10 feet into moderate sensitivity formations requires monitoring. This project requires approximately 3,000 CY of excavation up to 20 to 25 feet in depth. Fossil resources have been recorded within a close enough proximity to the project site to warrant paleontological monitoring given the excavation depths. Implementation of paleontological monitoring, per the Mitigation, Monitoring, and Reporting Program found in Section V. of the MND, would reduce any potential impacts to below a level of significance.

- d) Disturb and human remains, including those interred outside of formal cemeteries?

No buried human remains are known to exist within the project site. However, in the event that remains are encountered during construction, all work is required to stop, and a coroner called to assess any such findings in accordance with the City Greenbook standards. Following City procedure would result in a less than significant impact.

VI. GEOLOGY AND SOILS – Would the project:

- a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
- i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

The proposed project site lies within a region of California that contains many active and potentially active faults and is considered an area of moderate seismic activity. An "active" fault is defined by the State of California as a fault that has had surface displacement within Holocene time (approximately the last 11,000 years). A "potentially active" fault is defined as a fault that has shown evidence of surface displacement during the Quaternary (last 1.6 million years), unless direct geologic evidence demonstrates inactivity for all of the Holocene or longer. This definition does not, of course, mean that faults lacking evidence of surface displacement are necessarily inactive. "Sufficiently active" is also used to describe a fault if there is some evidence that Holocene displacement occurred on one or more of its segments or branches (Hart, 1997). The nearest active fault to the project site is the Newport Inglewood/Rose Canyon fault zone, which is approximately 0.5-mile east.

Implementation of the proposed project, which would replace the reservoir, pump station, and associated pipelines, would not result in the creation of new structures or land uses that would attract a higher, permanent intensification of people at the project site. Project construction would temporarily place more people at the site; however, given the short-term nature of the project and the fact that no new structures are proposed, potential impacts to people or new structures associated with the possible rupture of a known fault, such as the Newport Inglewood/Rose

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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Canyon fault would be less than significant.

- | | | | | |
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| ii) Strong seismic ground shaking? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|------------------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|

The geotechnical investigation for the proposed project, dated February 28, 2012, indicates that the project is subject to ground shaking resulting from a movement along an active fault zone within the vicinity of the site. However, the project would be built to the standards and requirements of the California Building Code and other regulations, plans, and standards. The California Building Code requires specific provisions for seismic design to mitigate and minimize the effects of earthquakes and ground shaking on structures. Compliance with the California Building Code and other applicable regulations and plans would reduce impacts associated with strong seismic ground shaking to a less than significant level.

- | | | | | |
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| iii) Seismic-related ground failure, including liquefaction? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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The geotechnical investigation indicates that the project is located in Geologic Hazards Category 27 (Slide Prone Formations). According to the boring results, this site is underlain by the Mount Soledad Formation, which is a very dense, silty and clayey sandstone and conglomerate not subject to liquefaction. According to the geotechnical investigation, there is minimal risk associated with the slide prone formations at this site. Impacts would be less than significant.

- | | | | | |
|-----------------|--------------------------|--------------------------|-------------------------------------|--------------------------|
| iv) Landslides? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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According to the geotechnical investigation, the project site is located in Geologic Hazards Category 27, which is assigned to areas underlain by the slide-prone Mount Soledad Formation. Test borings of the soil at the site showed that the site is comprised of very dense, silty and clayey sandstone and conglomerate. The investigation concluded that the risk normally associated with this slide-prone formation at the project site could be considered minimal. Impacts would be less than significant.

- | | | | | |
|---|--------------------------|--------------------------|-------------------------------------|--------------------------|
| b) Result in substantial soil erosion or the loss of topsoil? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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Implementation of the proposed project would involve the replacement of a reservoir, pump station, and associated pipelines. Minimal disturbance to areas outside of the existing reservoir and pump station footprint would occur primarily during construction. The replacement of the reservoir and pump station would not result in erosion or the loss of topsoil. Application of project best management practices (BMPs) required during construction would ensure that erosion and loss of topsoil is minimized. Therefore, overall impacts resulting from soil erosion or the loss of topsoil would be less than significant.

- | | | | | |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|
| c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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According to the geotechnical investigation, this site is underlain by the Mount Soledad Formation, which is a very dense, silty and clayey sandstone and conglomerate formation that is slide-prone, but not subject to liquefaction. At the project site in particular, however, the geotechnical

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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investigation concludes that the risk normally associated with the Mount Soledad Formation would be considered minimal. Given the nature of the proposed project, i.e., a reservoir and pump station with shallow spread footings for the pump station and a rigid foundation system for the reservoir, the project would not be expected to destabilize the project area, resulting in landslides, lateral spreading, subsidence, liquefaction, or collapse. Impacts would be less than significant.

- d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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Subsurface soils in and around the project site consist of fill and very old paralic deposits which are underlain by the Mount Soledad Formation. It is anticipated that grading would consist of excavating to the planned bottom of the reservoir. In general, excavated materials can be placed as fill with no threat of expansion. Any imported soil would consist of non-detrimentally expansive materials, free of organics and rock greater than three inches in maximum dimension. The project site contains soils that generally have a low potential for expansion and imported soils would be checked for expansive materials; therefore, risks to life or property as a result of implementation of the proposed project would be less than significant.

- e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
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The project does not propose any septic tanks or alternative waste disposal methods. No impact would result.

VII. GREENHOUSE GAS EMISSIONS – Would the project:

- a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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The City of San Diego is using the California Air Pollution Control Officers Association (CAPCOA) report "CEQA and Climate Change" (CAPCOA 2009) to determine whether a GHG analysis would be required for submitted projects. The CAPCOA report references a 900 metric ton guideline as a conservative threshold for requiring further analysis and possible mitigation. This emission level is based on the amount of vehicle trips, the typical energy and water use associated with projects, and other factors.

Based on previous Urbemis Models (2007 9.2.4) that were run for similarly sized City projects, this project is estimated to generate between 150 and 200 MT/year of GHG emissions. For comparison, the construction of a new 2.0 million gallon Catalina Standpipe project was estimated to generate 90 MT/year and the Scripps Ranch Pump Station, which is a much larger facility than this was estimated to generate emissions of 95 MT/year. The model uses project information (e.g., total construction months, project type, construction equipment, grading quantities, and the total disturbance area, etc.) to quantify GHG emissions from heavy duty construction equipment, haul trucks, and worker commute trips associated with linear construction projects.

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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The emissions for the project will fall well below the 900 metric ton per year figure. Therefore, the project would result in a less than significant CEQA Greenhouse gas impact and mitigation would not be required.

- | | | | | |
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| b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|---|--------------------------|--------------------------|--------------------------|-------------------------------------|

See VII.a. above. The project would not conflict with any adopted applicable plans, policies, or regulations related to greenhouse gases.

VIII. HAZARDS AND HAZARDOUS MATERIALS – Would the project:

- | | | | | |
|---|--------------------------|--------------------------|-------------------------------------|--------------------------|
| a) Create a significant hazard to the public or the environment through routine transport, use, or disposal of hazardous materials? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|---|--------------------------|--------------------------|-------------------------------------|--------------------------|

Implementation of the proposed project would result in the temporary use of construction vehicles and equipment. Any movement of vehicles transporting or disposing of hazardous materials to and from the project site will be short term, and would cease upon completion of construction activities. Therefore, potential impacts associated with the routine transport, use, or disposal of hazardous materials as a result of the proposed project construction would be less than significant.

The project proposes the replacement of the existing reservoir, pump station, and associated appurtenances. Both the reservoir and the pump station would be constructed in approximately the same location as the existing reservoir and pump station. The proposed reservoir and pump station would not generate or necessitate the use of hazardous materials during their operation; therefore, it is not anticipated that any hazardous materials would be routinely transported, used, or disposed of during operation of the new facility. No significant hazards to the public or the environment would be created during operation.

- | | | | | |
|---|--------------------------|--------------------------|-------------------------------------|--------------------------|
| b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|---|--------------------------|--------------------------|-------------------------------------|--------------------------|

The project proposes the replacement of the existing reservoir and pump station and associated appurtenances. Both the reservoir and the pump station will be constructed in approximately the same location as the existing reservoir and pump station. The existing reservoir and pump station do not generate hazardous materials during their operation; therefore, it is not anticipated that any hazardous materials would be discovered and released into the environment during the construction of the new facility. In addition, as mentioned above, it is not anticipated that the new facility would require the use or would cause the generation of hazardous materials. Therefore, no release of hazardous materials into the environment would occur. Impacts would be less than significant.

- | | | | | |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| c) Emit hazardous emissions or handle hazardous or acutely | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
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Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?

The project is not within one-quarter mile of an existing school. It is not anticipated that any hazardous materials would be discovered during project implementation and therefore, the public would not be impacted by hazardous materials. No impact would occur.

- d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?

The project site is not included on a list of hazardous materials sites and therefore implementation of the project would not create a significant hazard to the public or environment. No impact would result.

- e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?

The project site is not located in an airport land use plan or within two miles of a public airport. The project would not result in a safety hazard for people residing or working in the project area. No impact would result.

- f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?

The project is not located within the vicinity of a private airstrip. As such, the project would not result in a safety hazard for people residing or working in the project area. No impact would result.

- g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?

Once constructed, it is not anticipated that the project would interfere with an adopted emergency response or evacuation plan. In addition, the construction staging area is proposed on-site or at the La Jolla View Reservoir and not within the public right-of-way. Thus, construction staging would not block emergency response or evacuation efforts. The project is set back from public rights-of-way, and would not physically interfere with emergency access. No impact would occur.

- h) Expose people or structures to a

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
<p>significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?</p>				

The project proposes to revegetate the disturbed areas once work on the reservoir and pump station is complete. The re-vegetation plan would blend with the existing ornamental vegetation and adhere to all City of San Diego brush management requirements. As such, project implementation would not expose people or structures to a significant risk of loss, injury or death involving wildland fires. Impacts would be less than significant.

IX. HYDROLOGY AND WATER QUALITY - Would the project:

- a) Violate any water quality standards or waste discharge requirements?

Based on the City of San Diego Storm Water Standards Section 2, the project does not meet any of the criteria for Priority Development Projects and is subject to only the Standard Development Project requirements for Permanent Best Management Practices. The project would include source control measures and implementation of Low Impact Development design practices such as preservation of existing landscaping, use of low water use landscaping, and directing runoff from buildings and parking areas into planting areas. The project would not violate any water quality standards or waste discharge requirements. Impacts would be less than significant.

- b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?

The project does not propose the use of groundwater nor would it impact groundwater during grading activities. Furthermore, the project would not introduce a substantially large amount of new impervious surfaces over ground that could interfere with groundwater recharge. Therefore, the project would not substantially deplete groundwater supplies or interfere substantially with groundwater recharge. No impact would result.

- c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner, which would result in substantial erosion or siltation on- or off-site?

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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Any vegetation removed during the construction process would be revegetated once construction is completed. In addition, the new reservoir and pump station would be located in approximately the same location and would be approximately the same size as the existing facility. As such, the existing drainage pattern would not be substantially altered and would not result in erosion or siltation on or off-site. Impacts would be less than significant.

- d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner, which would result in flooding on- or off-site?
- | | | | | |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|

Any vegetation removed during the construction process would be revegetated once the project is completed. In addition, the project does not propose a substantial increase to the footprint over the existing facility. The existing drainage pattern would not be substantially altered and would not result in the alteration of a course of a stream or river or in flooding on- or off-site. The existing drainage pattern of the site would largely remain intact. Impacts would be less than significant.

- e) Create or contribute runoff water, which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?
- | | | | | |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|

The project does not propose a substantial increase to the footprint over the existing facility; therefore, the project would not result in an increase in storm water volume, frequency or velocity nor will it significantly reduce existing infiltration rates. Impacts would be less than significant.

- f) Otherwise substantially degrade water quality?
- | | | | | |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|-------------------------------------|--------------------------|

See sections IX(a)(c)(d) and (e). Impacts would be less than significant.

- g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?
- | | | | | |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project is not a housing project; nor is it located within the 100-year flood plain or other flood hazard area. No impact would result.

- h) Place within a 100-year flood hazard area, structures that would impede or redirect flood flows?
- | | | | | |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project site is located in Zone X as identified on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) number 06073C. Zone X refers to areas outside of the

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
0.2-percent annual chance floodplain and describes areas with a minimal risk of flood. No impact would result.				

X. LAND USE AND PLANNING – Would the project:

- a) Physically divide an established community?

The project proposes the replacement of the existing reservoir and pump station and associated pipelines (appurtenances). Both the reservoir and the pump station would be constructed in approximately the same location as the existing reservoir and pump station; therefore, project implementation would not result in the division of an established community. No impact would result.

- b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?

The project consists of upgrades to existing public infrastructure. The project would not alter the site's land use and is consistent with the policies, goals and recommendations of the General Plan and the La Jolla Community Plan. After construction, which would require paleontological monitoring, the project would have no additional environment effects above and beyond those of the existing reservoir and pump station. Therefore, it would not conflict with any land use planning document for the community. No impact would result.

- c) Conflict with any applicable habitat conservation plan or natural community conservation plan?

The project site is located outside of the Multi-Habitat Planning Area (MHPA) and would not conflict with the City's Biological Guidelines or the Multiple Species Conservation Program (MSCP) Subarea Plan; however, due to the proximity to songbird and raptor nesting habitat, the project's biological assessment recommended that work occur outside the general breeding season from February 1 to September 15. If this is not possible, then a pre-construction nest survey by a qualified biologist should be performed within 10 days prior to vegetation impacts in order to comply with the Migratory Bird Treaty Act. Impacts would be less than significant.

XI. MINERAL RESOURCES – Would the project?

- a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?

The area surrounding the project is not being used for the recovery of mineral resources, nor is it

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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designated for the recovery of mineral resources on the City of San Diego General Plan Land Use Map. Therefore, the project would not result in the loss of availability of a known mineral resource. No impact would result.

- b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project would not result in the loss of the availability of a locally important mineral resource. There are no existing quarries within close proximity to the site. The project site and its surrounding are not zoned for mineral resources. As such, project implementation would not result in the loss of availability of a locally important mineral resource recover site. No impact would result.

XII. NOISE – Would the project result in:

- a) Generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|-------------------------------------|--------------------------|

The project would not result in a permanent substantial increase in the existing noise environment. Noise dampening panels would be mounted on the inside face of the building walls and roof structure. The pump station would be designed to meet the current City Ordinance limit of 40 dBA at the facility property line (including during emergency generator operation). Noise-proof enclosures would be installed around the heating/ventilation/air conditioning (HVAC) equipment to dampen noise and maintain the 40 dBA requirement at the property line. Impacts would be less than significant.

- b) Generation of, excessive ground borne vibration or ground borne noise levels?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

Excessive vibration or ground borne noise levels are not anticipated during construction or once the project is complete and operating. The project would not include construction activities that would result in substantial levels of ground borne vibration or noise, such as blasting or pile driving. Once in operation, the project would maintain the 40 dBA requirement at the property line. No impact would result.

- c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|-------------------------------------|--------------------------|

See XII.a. An existing reservoir and pump station currently exist on-site. Any operational noise from the proposed project would not be in excess of the current noise levels. Noise dampening measures would be installed to meet local standards; therefore, the project would not result in ambient noise levels above the 40 dBA requirement at the property line. Impacts would be less than significant.

- d) A substantial temporary or
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|-------------------------------------|--------------------------|

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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periodic increase in ambient noise levels in the project vicinity above existing without the project?

The project site is subject to noise typical of an urban neighborhood, such as residential traffic on local streets. The planned new pump station would have a variety of noise sources. These noise sources vary from the pump equipment to the new generator; however, the project would be designed to meet the current City Ordinance limit of 40 dBA at the facility property line. Impacts would be less than significant.

- e) For a project located within an airport land use plan, or, where such a plan has not been adopted, within two miles of a public airport or public use airport would the project expose people residing or working in the area to excessive noise levels?

The project site is not located in an airport land use plan or within two miles of a public airport. The project would not expose people residing or working in the project area to excessive noise levels. No impact would result.

- f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

The project site is not located in the vicinity of a private airstrip. The project would not expose people residing or working in the project area to excessive noise levels. No impact would result.

XIII. POPULATION AND HOUSING – Would the project:

- a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?

The project has reached the end of its useful lifespan and needs to be upgraded to provide a more efficient means to supply water to existing and future population levels; however, any expansion beyond the existing facility is negligible. The proposed improvements are not associated with growing demand. No impact would result.

- b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?

Project implementation would not displace any housing. Therefore, the construction of housing elsewhere would not be necessitated. No impact would result.

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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- c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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Project implementation would not displace any people. Therefore, the construction of housing elsewhere would not be necessitated. No impact would result.

XIV. PUBLIC SERVICES

- a) Would the project result in substantial adverse physical impacts associated with the provisions of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

- i) Fire Protection

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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The replacement and installation of the reservoir and pump station would not alter any fire protection response times, facilities or impact the operation of fire personnel. The project would not result in the need for new or physically altered fire protection facilities. No impact would result.

- ii) Police Protection

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
--------------------------	--------------------------	--------------------------	-------------------------------------

The replacement and installation of the reservoir and pump station would not alter any police protection response times, facilities or impact the operation of police personnel. The project would not result in the need for new or physically altered police protection facilities. No impact would result.

- iii) Schools

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
--------------------------	--------------------------	--------------------------	-------------------------------------

The replacement and installation of the reservoir and pump station would not result in the need for new or physically altered schools. No impact would result.

- v) Parks

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
--------------------------	--------------------------	--------------------------	-------------------------------------

The project would not physically alter parks or create new housing. Therefore, the project would not create demand for new parks or recreational facilities. No impact would result.

- vi) Other public facilities

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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The project would not result in the increased demand for electricity, gas, or other public facilities. The project would improve existing infrastructure (water pump station, reservoir, and pipelines) and would not impact any other public facilities. No impact would result.

XV. RECREATION

- a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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accelerated?

The project would not result in the building of residential units and would, therefore, not result in an increase in demand for recreational facilities. Substantial physical deterioration of a recreational facility would not occur or be accelerated as a result of the development of the proposed project. No impact would result.

- b) Does the project include recreational facilities or require the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment?

The project would not result in the building or expansion of recreational facilities and would, therefore, not result in an adverse physical effect on the environment from the construction or expansion of recreational facilities. No impact would result.

XVI. TRANSPORTATION/TRAFFIC – Would the project?

- a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?

The project includes the replacement of an existing reservoir and pump station and would not create additional traffic beyond the existing maintenance needs of the facility once it is constructed. Construction traffic would increase traffic along haul routes, but this impact is temporary and the construction staging area would be located on the project site or at the La Jolla View Reservoir and not in the right-of-way. Therefore, there would be no conflict with a plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system. Impacts would be less than significant.

- b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?

The project includes the replacement of an existing reservoir and pump station and would not necessitate additional traffic beyond the existing maintenance need of the facility once it is

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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constructed. Construction traffic would increase traffic along haul routes, but this impact is temporary and the construction staging area is located on the project site or at the La Jolla View Reservoir, not in the right-of-way. Therefore, there would be no conflict with any applicable congestion management program. Impacts would be less than significant.

- c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project would not result in a change in air traffic patterns or an increase in traffic levels or location resulting in substantial safety risks. Therefore, no impact will occur.

- d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project would not result in hazards due to a design feature or incompatible use. Construction staging would occur on-site on the reservoir's access road or at the La Jolla View Reservoir, and the area's circulation system would largely perform as it does in existing conditions. No impact would result.

- e) Result in inadequate emergency access?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|-------------------------------------|--------------------------|

Adequate emergency access would be available during construction and operation of the facility. Due to the construction staging located on the project site or at the La Jolla View Reservoir, the right-of-way access would not be compromised. Impacts would be less than significant.

- f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project includes the replacement of a reservoir and pump station. Any construction traffic that is generated by the project is temporary. Therefore, the project would not conflict with plans or programs regarding public transit, bicycle, or pedestrian facilities or decrease their performance. No impact would result.

XVII. UTILITIES AND SERVICE SYSTEMS – Would the project:

- a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project includes the replacement of a water reservoir and pump station. The project would not produce wastewater, and thus, would not exceed wastewater treatment requirements of the San Diego Regional Water Quality Control Board. No impact would result.

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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- b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project consists of the replacement of an existing reservoir, pump station and underground water pipelines. The project is a necessary upgrade to existing water facilities. It would not require or result in the construction and expansion of water or wastewater treatment facilities. No impact would result.

- c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|-------------------------------------|--------------------------|

The project includes the replacement of a water reservoir and pump station and would not result in a substantial change to the on-site drainage pattern. Runoff volume generated from the completed project would not be significantly different from the existing runoff volume. The project would not require or result in construction of new storm water drainage facilities or the expansion of existing facilities. Impacts would be less than significant.

- d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project includes the replacement of a water reservoir and pump station with negligible expansion. Sufficient water supplies are available and this project would improve the efficiency of the system. No new or expanded entitlements are needed. No impact would result.

- e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?
- | | | | |
|--------------------------|--------------------------|--------------------------|-------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|-------------------------------------|

The project is the replacement of a water reservoir and pump station. The project would have no impact on the demand on the existing wastewater treatment system. No impact would result.

- f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?
- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
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The solid waste generated by this project would be disposed of in conformance with all applicable

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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local and state regulations pertaining to solid waste including permitting capacity of the landfill serving the project area. Implementation of the proposed project is anticipated to generate debris related to the replacement of the pump station and reservoir. The proposed project is not expected to generate amounts of debris great enough to affect the permitted capacity of local landfills. Operation of the project would not generate waste and therefore would not affect the permitting capacity of the landfill serving the project area. Therefore, this impact would be less than significant.

- g) Comply with federal, state, and local statutes and regulation related to solid waste?

Any solid waste generated during construction related activities would be recycled or disposed of in accordance with all applicable local, state and federal regulations. No impact would result.

XVIII. MANDATORY FINDINGS OF SIGNIFICANCE –

- a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?

The preceding analysis does not reveal any immitigable impacts to the environment. The project is located entirely within a developed parcel in a developed urbanized neighborhood and would not degrade the quality of the surrounding environment. The project has the potential to result in impacts to paleontological resources requiring monitoring during excavation activities. Implementation of the MMRP found in Section V. of the MND would reduce potential impacts to paleontological resources to below a level of significance. The project is not located within the City's MHPA; however due to the project's proximity to potential songbird and raptor nesting habitat, the biological assessment for the proposed project recommended that work occur outside the general breeding season from February 1 to September 15. If this is not possible, then a pre-construction nesting survey by a qualified biologist should be performed within 10 days prior to vegetation impacts in order to comply with the Migratory Bird Treaty Act. With paleontological monitoring, impacts would be less than significant.

- b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other

Issue	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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current projects, and the effects of probable futures projects)?

The potential for cumulative impacts occurs when the independent impacts of the project are combined with the impacts of related projects in proximity to the project site such that the impacts that occur are greater than the project alone. As discussed above, with the exception of paleontological resources, it has been determined that the project would have no impacts, or impacts would be less than significant. Other impacts associated with the proposed project, including emissions, noise, and traffic generated by construction activities, would be temporary, largely localized to the project site itself, and less than significant. Given the temporary nature of the proposed project in both its implementation and impacts, any contribution it would have to a cumulatively considerable impact on the environment is considered less than significant.

c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?

As stated previously, potentially significant impacts have been identified for paleontological resources only. The proposed project is located on a previously graded site within a developed residential area of San Diego. The project is consistent with the planning objectives of the community in which it is located. Mitigation has been included in Section V of this MND to reduce impacts to paleontological resources to below a level of significance. As such, project implementation would not result in substantial adverse impacts to the environment or human beings. No impacts would result.

INITIAL STUDY CHECKLIST

REFERENCES

I. Aesthetics / Neighborhood Character

- City of San Diego General Plan.
- Community Plans:
- Local Coastal Plan.

II. Agricultural Resources & Forest Resources

- City of San Diego General Plan
- U.S. Department of Agriculture, Soil Survey - San Diego Area, California, Part I and II, 1973
- California Agricultural Land Evaluation and Site Assessment Model (1997)
- Site Specific Report:

III. Air Quality

- California Clean Air Act Guidelines (Indirect Source Control Programs) 1990
- Regional Air Quality Strategies (RAQS) - APCD
- Site Specific Report:

IV. Biology

- City of San Diego, Multiple Species Conservation Program (MSCP), Subarea Plan, 1997
- City of San Diego, MSCP, "Vegetation Communities with Sensitive Species and Vernal Pools" Maps, 1996
- City of San Diego, MSCP, "Multiple Habitat Planning Area" maps, 1997
- Community Plan - Resource Element
- California Department of Fish and Game, California Natural Diversity Database, "State and Federally-listed Endangered, Threatened, and Rare Plants of California," January 2001
- California Department of Fish & Game, California Natural Diversity Database, "State and Federally-listed Endangered and Threatened Animals of California," January 2001
- City of San Diego Land Development Code Biology Guidelines
- Site Specific Report: Biological Assessment for the La Jolla Country Club Reservoir Replacement Project; WBS# B-11024.02.06, PTS # 327584, dated February 20, 2014, and prepared by Katherine Comer Santos, Biologist III, Environmental Permitting Section, Public Works Department

V. Cultural Resources (includes Historical Resources)

- City of San Diego Historical Resources Guidelines
- City of San Diego Archaeology Library
- Historical Resources Board List
- Community Historical Survey:
- Site Specific Report: Historic Resource Technical Report, dated April 25, 2013 and prepared by IS Architecture

VI. Geology/Soils

- City of San Diego Seismic Safety Study
- U.S. Department of Agriculture Soil Survey - San Diego Area, California, Part I and II, December 1973 and Part III, 1975
- Site Specific Report: Geotechnical Investigation La Jolla Country Club Reservoir and Pump Station Project La Jolla, California, dated February 28, 2012, and prepared by Southern California Soil & Testing, Inc.

VII. Greenhouse Gas Emissions

- Site Specific Report:

VIII. Hazards and Hazardous Materials

- San Diego County Hazardous Materials Environmental Assessment Listing
- San Diego County Hazardous Materials Management Division
- FAA Determination
- State Assessment and Mitigation, Unauthorized Release Listing, Public Use Authorized
- Airport Land Use Compatibility Plan
- Site Specific Report:

IX. Hydrology/Water Quality

- Flood Insurance Rate Map (FIRM)

Federal Emergency Management Agency (FEMA), National Flood Insurance Program-Flood Boundary and Floodway Map

Clean Water Act Section 303(b) list, http://www.swrcb.ca.gov/tmdl/303d_lists.html

Site Specific Report:

X. Land Use and Planning

City of San Diego General Plan

Community Plan

Airport Land Use Compatibility Plan

City of San Diego Zoning Maps

FAA Determination

Other Plans:

XI. Mineral Resources

California Department of Conservation - Division of Mines and Geology, Mineral Land Classification

Division of Mines and Geology, Special Report 153 - Significant Resources Maps

Site Specific Report:

XII. Noise

City of San Diego General Plan

City of San Diego Municipal Code

San Diego International Airport - Lindbergh Field CNEL Maps

Brown Field Airport Master Plan CNEL Maps

Montgomery Field CNEL Maps

San Diego Association of Governments - San Diego Regional Average Weekday Traffic Volumes

San Diego Metropolitan Area Average Weekday Traffic Volume Maps, SANDAG

Site Specific Report:

XIII. Paleontological Resources

City of San Diego Paleontological Guidelines

Deméré, Thomas A., and Stephen L. Walsh, "Paleontological Resources City of San Diego," Department of Paleontology San Diego Natural History Museum, 1996

Kennedy, Michael P., and Gary L. Peterson, "Geology of the San Diego Metropolitan Area, California. Del Mar, La Jolla, Point Loma, La Mesa, Poway, and SW 1/4 Escondido 7 1/2 Minute Quadrangles," California Division of Mines and Geology Bulletin 200, Sacramento, 1975

Kennedy, Michael P., and Siang S. Tan, "Geology of National City, Imperial Beach and Otay Mesa Quadrangles, Southern San Diego Metropolitan Area, California," Map Sheet 29, 1977

Site Specific Report:

XIV. Population / Housing

City of San Diego General Plan

Community Plan

Series 11/Series 12 Population Forecasts, SANDAG

Other:

XV. Public Services

City of San Diego General Plan

Community Plan

XVI. Recreational Resources

City of San Diego General Plan

Community Plan

Department of Park and Recreation

City of San Diego - San Diego Regional Bicycling Map

Additional Resources:

XVII. Transportation / Circulation

City of San Diego General Plan

Community Plan

San Diego Metropolitan Area Average Weekday Traffic Volume Maps, SANDAG

San Diego Region Weekday Traffic Volumes, SANDAG

Site Specific Report:

XVIII. Utilities

___ Site Specific Report :

XIX. Water Conservation

___ Sunset Magazine, New Western Garden Book, Rev. ed. Menlo Park, CA: Sunset Magazine

Created: REVISED - October 11, 2013

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.

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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.

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- 8.5 If damage occurs to Water Department property (i.e. fire hydrant meter, backflow, various appurtenances), the cost of repairs or replacements will be charged to the customer of record (applicant).

**Larry Gardner
Water Department Director**

- Tab: 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="checkbox"/>	<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:	
Guarantees Payment of all Charges Resulting from the use of this Meter. Insures that employees of this Organization understand the proper use of Fire Hydrant Meter			

Fire Hydrant Meter Removal Request		Requested Removal Date:	
Provide Current Meter Location If Different from Above:			
Signature:		Title:	Date:
Phone: ()		Pager: ()	

<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

City of San Diego, Field Engineering Div., 9485 Aero Drive, SD CA 92123		Contractor's Name:	
Project Name:		Contractor's Address:	
Work Order No or Job Order No.			
City Purchase Order No.		Contractor's Phone #:	Invoice No.
Resident Engineer (RE):		Contractor's fax #:	Invoice Date:
RE Phone#:	Fax#:	Contact Name:	Billing Period: (to

Item #	Item Description	Contract Authorization				Previous Totals To Date		This Estimate		Totals to Date	
		Unit	Price	Qty	Extension	%/QTY	Amount	% / QTY	Amount	% / QTY	Amount
1					\$ -		\$ -		\$ -	0.00%	\$ -
2					\$ -		\$ -		\$ -	0.00%	\$ -
3					\$ -		\$ -		\$ -	0.00%	\$ -
4					\$ -		\$ -		\$ -	0.00%	\$ -
5					\$ -		\$ -		\$ -	0.00%	\$ -
6					\$ -		\$ -		\$ -	0.00%	\$ -
7					\$ -		\$ -		\$ -	0.00%	\$ -
8					\$ -		\$ -		\$ -	0.00%	\$ -
9					\$ -		\$ -		\$ -	0.00%	\$ -
10					\$ -		\$ -		\$ -	0.00%	\$ -
11					\$ -		\$ -		\$ -	0.00%	\$ -
12					\$ -		\$ -		\$ -	0.00%	\$ -
13					\$ -		\$ -		\$ -	0.00%	\$ -
14					\$ -		\$ -		\$ -	0.00%	\$ -
15					\$ -		\$ -		\$ -	0.00%	\$ -
16					\$ -		\$ -		\$ -	0.00%	\$ -
17	Field Orders				\$ -		\$ -		\$ -	0.00%	\$ -
18					\$ -		\$ -		\$ -	0.00%	\$ -
	CHANGE ORDER No.				\$ -		\$ -		\$ -	0.00%	\$ -
					\$ -		\$ -		\$ -	0.00%	\$ -
Total Authorized Amount (including approved Change Order)					\$ -		\$ -		\$ -	Total Billed	\$ -

SUMMARY

A. Original Contract Amount	\$ -
B. Approved Change Order #00 Thru #00	\$ -
C. Total Authorized Amount (A+B)	\$ -
D. Total Billed to Date	\$ -
E. Less Total Retention (5% of D)	\$ -
F. Less Total Previous Payments	\$ -
G. Payment Due Less Retention	\$0.00
H. Remaining Authorized Amount	\$0.00

**I certify that the materials
have been received by me in
the quality and quantity specified**

Resident Engineer

Construction Engineer

Retention and/or Escrow Payment Schedule

Total Retention Required as of this billing (Item E)	\$0.00
Previous Retention Withheld in PO or in Escrow	\$0.00
Add'l Amt to Withhold in PO/Transfer in Escrow:	\$0.00
Amt to Release to Contractor from PO/Escrow:	

Contractor Signature and Date: _____

APPENDIX E
LOCATION MAP

La Jolla Country Club Reservoir and Pump Station

SENIOR ENGINEER
Hossein Azar
619-533-4102

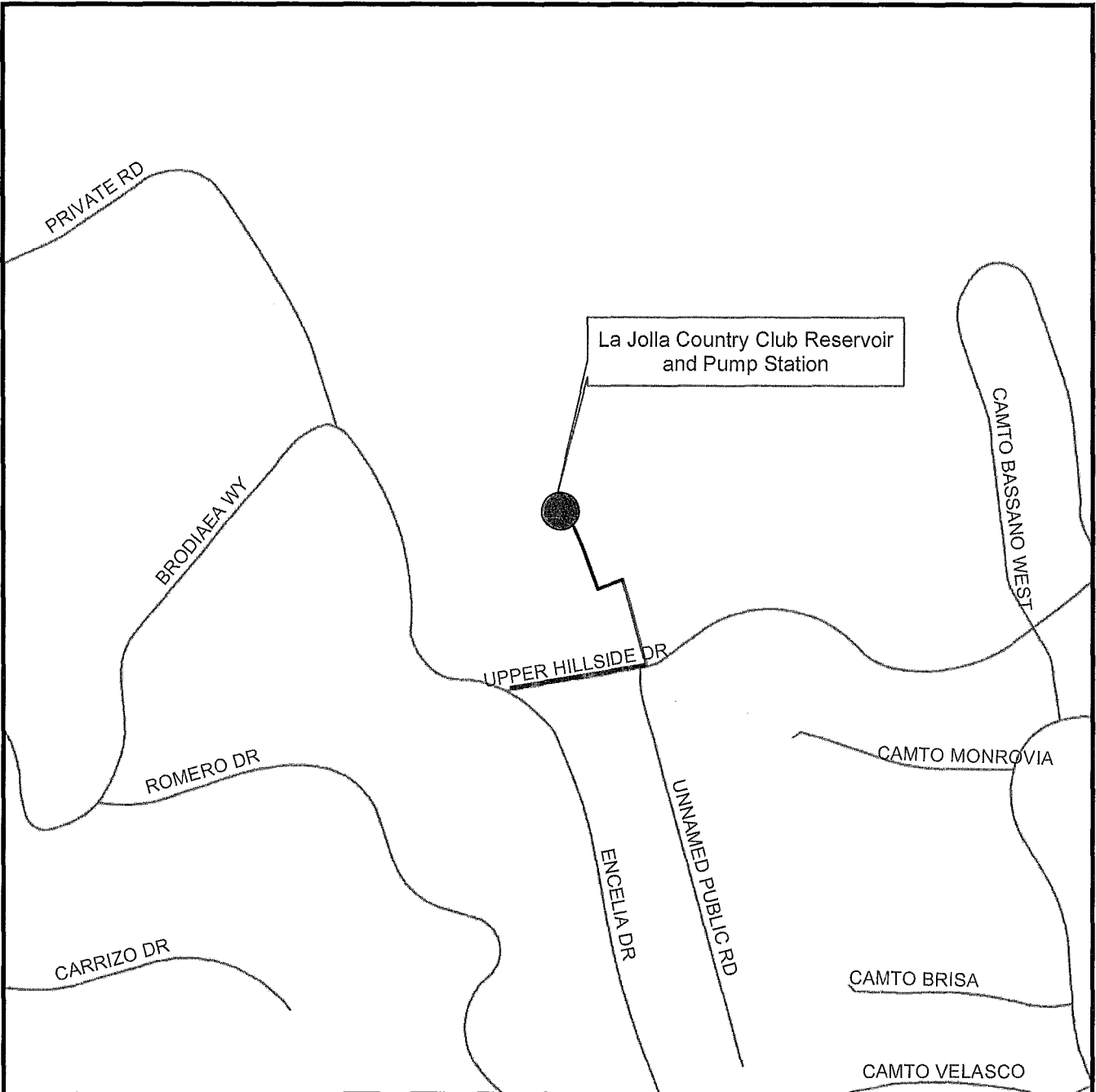
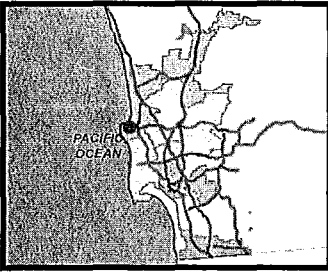
PROJECT MANAGER
David Manela
619-533-6682

PROJECT ENGINEER
Silvia Rendon
619-533-4246



CONSTRUCTION PROJECT
INFORMATION LINE
619-533-4207



Architectural Engineering & Parks



Legend

-  Point
-  LJCC_Line



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COMMUNITY NAME: La Jolla

COUNCIL DISTRICT: 1

SAP ID: B-11024

Date: April 18, 2014



APPENDIX F
HYDROSTATIC DISCHARGE FORM

APPENDIX

Hydrostatic Discharge Requirements Certification (Discharge Events < 500,000 gpd)

All discharge activities related to this project comply with the Regional Water Quality Control Board (RWQCB) Order No. 2002-0020, General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Water and Storm Drains as referenced by (http://www.swrcb.ca.gov/rwqcb9/board_decisions/adopted_orders/2002/2002_0020.shtml), and as follows:

Discharged water has been dechlorinated to below 0.1 (mg/l) level; and effluent has been maintained between 6 and 9 (PH) based on:							is discharge within acceptable limits?		Comment
Event #	Discharge Date & Amount (GAL)	Discharge Time	Meter Readings (at source)	Test Results (Chlorine / PH)	Name of Personnel Conducting Tests (print)	*signature of personnel	yes	no	
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						
	Date	Start:	Start:						
	Amt:	End:	End:						

*By signing, I certify that all of the statements and conditions for hydrostatic discharge events are correct.

Project Name: _____

Work Order No.(s): _____

Have any thresholds have been exceeded? Per Order No. 2002-0020, would this be a reportable discharge and must be reported within 24 hours of the event? [Reportable discharge would include violation of maximum gallons per day, any upset which exceeds any effluent limit]

APPENDIX G
HAZARDOUS LABEL/FORMS

HAZARDOUS WASTE

STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY
AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES

GENERATOR NAME _____

ADDRESS _____ 24 HRL. PHONE _____

CITY _____ STATE _____ ZIP _____

EPA ID NO. _____ MANIFEST DOCUMENT NO. _____

EPA WASTE NO. _____ CA WASTE NO. _____ ACCUMULATION START DATE _____

CONTENTS, COMPOSITION _____

PROPER DOT SHIPPING NAME _____

TECHNICAL NAME (S) _____

UNWA NO. WITH PREFIX _____

PHYSICAL STATE | HAZARDOUS PROPERTIES FLAMMABLE TOXIC
 SOLID LIQUID | CORROSIVE REACTIVE OTHER _____

HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

INCIDENT/RELEASE ASSESSMENT FORM ¹

If you have an emergency, Call 911

Handlers of hazardous materials are required to report releases. The following is a tool to be used for assessing if a release is reportable. Additionally, a non-reportable release incident form is provided to document why a release is not reported (see back).

Questions for Incident Assessment:

	YES	NO
1. Was anyone killed or injured, or did they require medical care or admitted to a hospital for observation?	<input type="checkbox"/>	<input type="checkbox"/>
2. Did anyone, other than employees in the immediate area of the release, evacuate?	<input type="checkbox"/>	<input type="checkbox"/>
3. Did the release cause off-site damage to public or private property?	<input type="checkbox"/>	<input type="checkbox"/>
4. Is the release greater than or equal to a reportable quantity (RQ)?	<input type="checkbox"/>	<input type="checkbox"/>
5. Was there an uncontrolled or unpermitted release to the air?	<input type="checkbox"/>	<input type="checkbox"/>
6. Did an uncontrolled or unpermitted release escape secondary containment, or extend into any sewers, storm water conveyance systems, utility vaults and conduits, wetlands, waterways, public roads, or off site?	<input type="checkbox"/>	<input type="checkbox"/>
7. Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements?	<input type="checkbox"/>	<input type="checkbox"/>
8. Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent?	<input type="checkbox"/>	<input type="checkbox"/>
9. Is the incident a threatened release (a condition creating a substantial probability of harm that requires immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment)?	<input type="checkbox"/>	<input type="checkbox"/>
10. Is there an increased potential for secondary effects including fire, explosion, line rupture, equipment failure, or other outcomes that may endanger or cause exposure to employees, the general public, or the environment?	<input type="checkbox"/>	<input type="checkbox"/>

If the answer is YES to any of the above questions – report the release to the California Office of Emergency Services at 800-852-7550 and the local CUPA daytime: (619) 338-2284, after hours: (858) 565-5255. Note: other state and federal agencies may require notification depending on the circumstances.

Call 911 in an emergency

If all answers are NO, complete a Non Reportable Release Incident Form (page 2 of 2) and keep readily available. Documenting why a “no” response was made to each question will serve useful in the event questions are asked in the future, and to justify not reporting to an outside regulatory agency.

If in doubt, report the release.

¹ This document is a guide for accessing when hazardous materials release reporting is required by Chapter 6.95 of the California Health and Safety Code. It does not replace good judgment, Chapter 6.95, or other state or federal release reporting requirements.

NON REPORTABLE RELEASE INCIDENT FORM

1. RELEASE AND RESPONSE DESCRIPTION

Incident # _____

Date/Time Discovered	Date/Time Discharge	Discharge Stopped <input type="checkbox"/> Yes <input type="checkbox"/> No
Incident Date / Time:		
Incident Business / Site Name:		
Incident Address:		
Other Locators (Bldg, Room, Oil Field, Lease, Well #, GIS)		
Please describe the incident and indicate specific causes and area affected. Photos Attached?: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Indicate actions to be taken to prevent similar releases from occurring in the future.		

2. ADMINISTRATIVE INFORMATION

Supervisor in charge at time of incident:	Phone:
Contact Person:	Phone:

3. CHEMICAL INFORMATION

Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Clean-Up Procedures & Timeline:	
Completed By:	Phone:
Print Name:	Title:

EMERGENCY RELEASE FOLLOW - UP NOTICE REPORTING FORM

A	BUSINESS NAME	FACILITY EMERGENCY CONTACT & PHONE NUMBER () -
B	INCIDENT MO DAY YR DATE	TIME OES NOTIFIED (use 24 hr time)
C	INCIDENT ADDRESS LOCATION	CITY / COMMUNITY COUNTY ZIP
D	CHEMICAL OR TRADE NAME (print or type)	CAS Number
E	CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A <input type="checkbox"/>	CHECK IF RELEASE REQUIRES NOTIFICATION UNDER 42 U.S.C. Section 9603 (a) <input type="checkbox"/>
F	PHYSICAL STATE CONTAINED <input type="checkbox"/> SOLID <input type="checkbox"/> LIQUID <input type="checkbox"/> GAS	PHYSICAL STATE RELEASED <input type="checkbox"/> SOLID <input type="checkbox"/> LIQUID <input type="checkbox"/> GAS
G	ENVIRONMENTAL CONTAMINATION <input type="checkbox"/> AIR <input type="checkbox"/> WATER <input type="checkbox"/> GROUND <input type="checkbox"/> OTHER	QUANTITY RELEASED TIME OF RELEASE DURATION OF RELEASE — DAYS — HOURS — MINUTES
H	ACTIONS TAKEN	
I	KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information) <input type="checkbox"/> ACUTE OR IMMEDIATE (explain) _____ <input type="checkbox"/> CHRONIC OR DELAYED (explain) _____ <input type="checkbox"/> NOTKNOWN (explain) _____	
J	ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS	
K	COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)	
L	CERTIFICATION: I certify under penalty of law that I have personally examined and I am familiar with the information submitted and believe the submitted information is true, accurate, and complete. REPORTING FACILITY REPRESENTATIVE (print or type) _____ SIGNATURE OF REPORTING FACILITY REPRESENTATIVE _____ DATE: _____	

EMERGENCY RELEASE FOLLOW-UP NOTICE REPORTING FORM INSTRUCTIONS

GENERAL INFORMATION:

Chapter 6.95 of Division 20 of the California Health and Safety Code requires that written emergency release follow-up notices prepared pursuant to 42 U.S.C. § 11004, be submitted using this reporting form. Non-permitted releases of reportable quantities of Extremely Hazardous Substances (listed in 40 CFR 355, appendix A) or of chemicals that require release reporting under section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. § 9603(a)] must be reported on the form, as soon as practicable, but no later than 30 days, following a release. The written follow-up report is required in addition to the verbal notification.

BASIC INSTRUCTIONS:

- The form, when filled out, reports follow-up information required by 42 U.S.C § 11004. Ensure that all information requested by the form is provided as completely as possible.
- If the incident involves reportable releases of more than one chemical, prepare one report form for each chemical released.
- If the incident involves a series of separate releases of chemical(s) at different times, the releases should be reported on separate reporting forms.

SPECIFIC INSTRUCTIONS:

Block A: Enter the name of the business and the name and phone number of a contact person who can provide detailed facility information concerning the release.

Block B: Enter the date of the incident and the time that verbal notification was made to OES. The OES control number is provided to the caller by OES at the time verbal notification is made. Enter this control number in the space provided.

Block C: Provide information pertaining to the location where the release occurred. Include the street address, the city or community, the county and the zip code.

Block D: Provide information concerning the specific chemical that was released. Include the chemical or trade name and the Chemical Abstract Service (CAS) number. Check all categories that apply. Provide best available information on quantity, time and duration of the release.

Block E: Indicate all actions taken to respond to and contain the release as specified in 42 U.S.C. § 11004(c).

Block F: Check the categories that apply to the health effects that occurred or could result from the release. Provide an explanation or description of the effects in the space provided. Use Block H for additional comments/information if necessary to meet requirements specified in 42 U.S.C. § 11004(c).

Block G: Include information on the type of medical attention required for exposure to the chemical released. Indicate when and how this information was made available to individuals exposed and to medical personnel, if appropriate for the incident, as specified in 42 U.S.C. § 11004(c).

Block H: List any additional pertinent information.

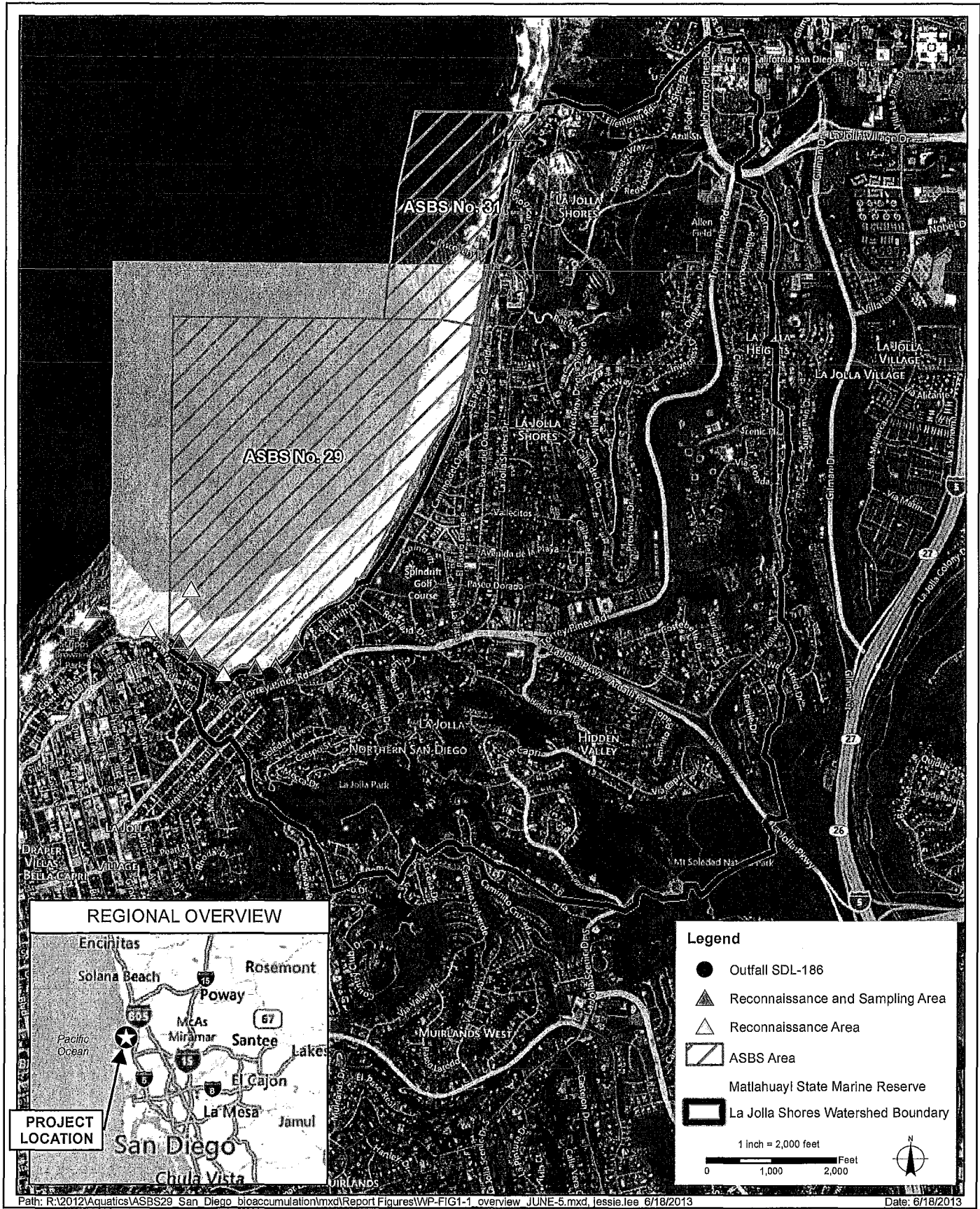
Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

MAIL THE COMPLETED REPORT TO:

**State Emergency Response Commission (SERC)
Attn: Section 304 Reports
Hazardous Materials Unit
3650 Schriever Avenue
Mather, CA 95655**

NOTE: Authority cited: Sections 25503, 25503.1 and 25507.1, Health and Safety Code. Reference: Sections 25503(b)(4), 25503.1, 25507.1, 25518 and 25520, Health and Safety Code.

APPENDIX H
AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE MAP



Project Overview
City of San Diego ASBS Bioaccumulation Study
San Diego, CA

FIGURE
1



APPENDIX I

SAMPLE OF PUBLIC NOTICES

FOR SAMPLE REFERENCE ONLY



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 7 a.m. to 4 p.m.

City of San Diego Contractor:

KTA Construction 619-719-3771

To contact the City of San Diego:  **Public Works**
619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP



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PROJECT TITLE

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APPENDIX J

ADVANCED METERING INFRASTRUCTURE (AMI) DEVICE PROTECTION

Protecting AMI Devices in Meter Boxes and on Street Lights

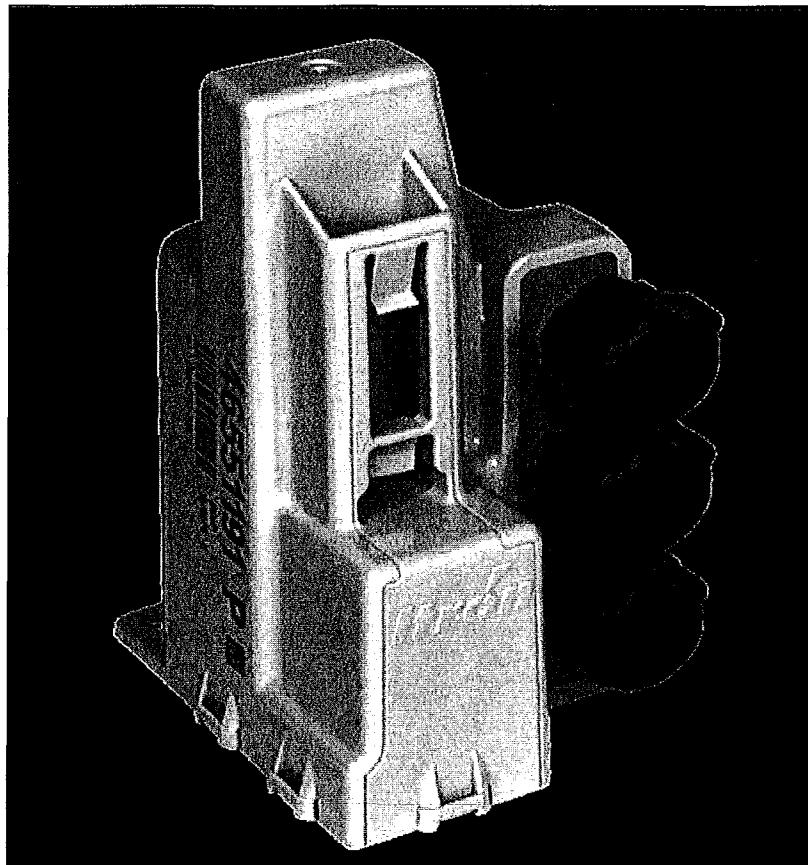
The Public Utilities Department (PUD) has begun the installation of the Advanced Metering Infrastructure (AMI) technology as a new tool to enhance water meter reading accuracy and efficiency, customer service and billing, and to be used by individual accounts to better manage the efficient use of water. **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:

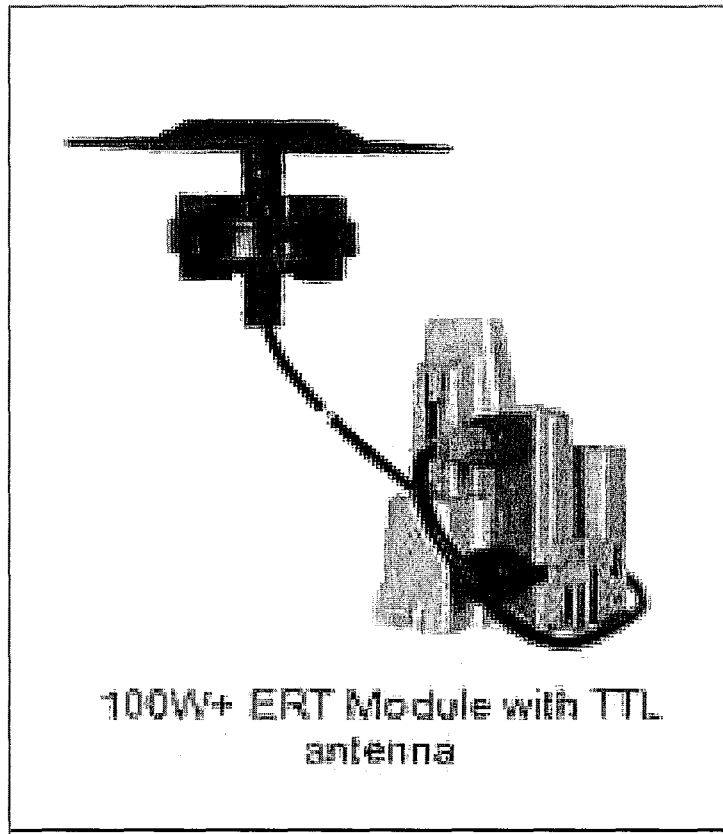
- A. Endpoints, see Photo 1:

Photo 1



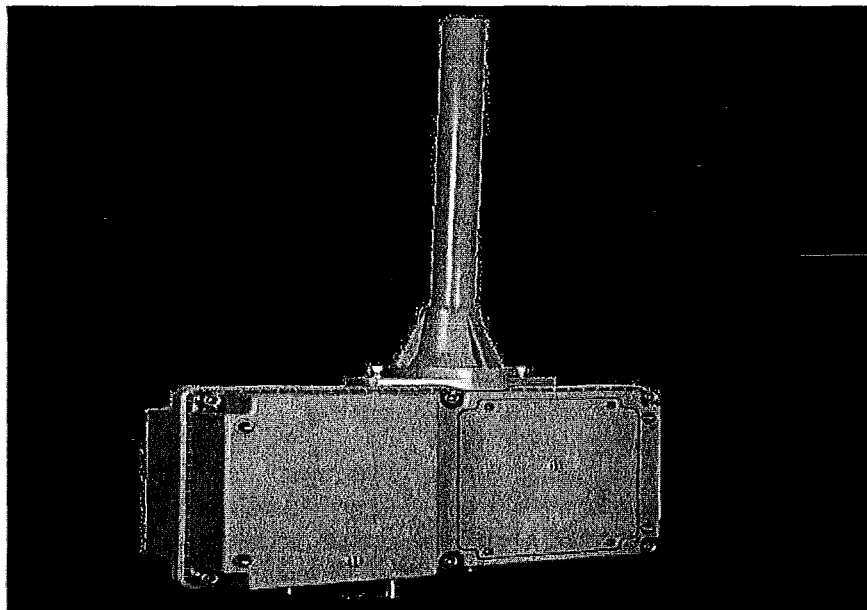
B. AMI Antenna attached to Endpoint (antenna not always required), see Photo 2:

Photo 2



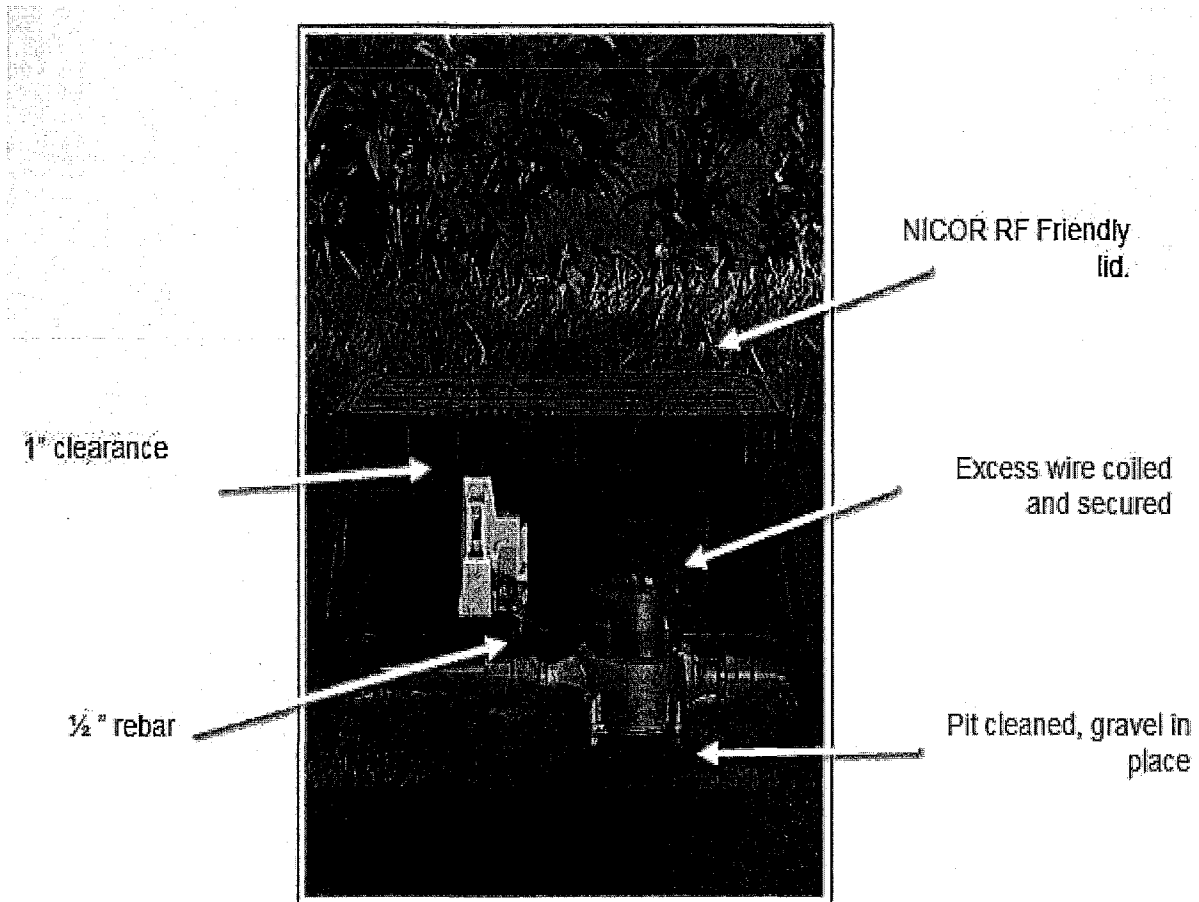
Network Devices, see Photo 3:

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

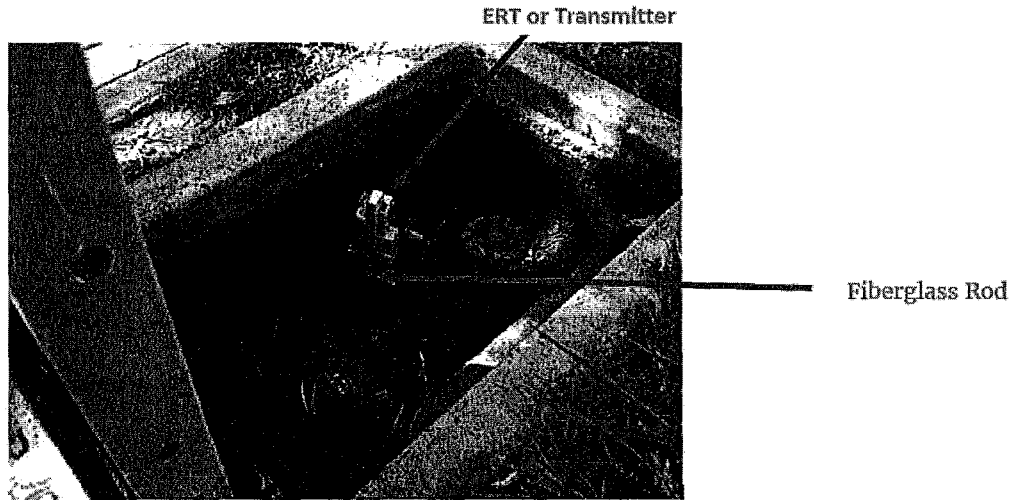
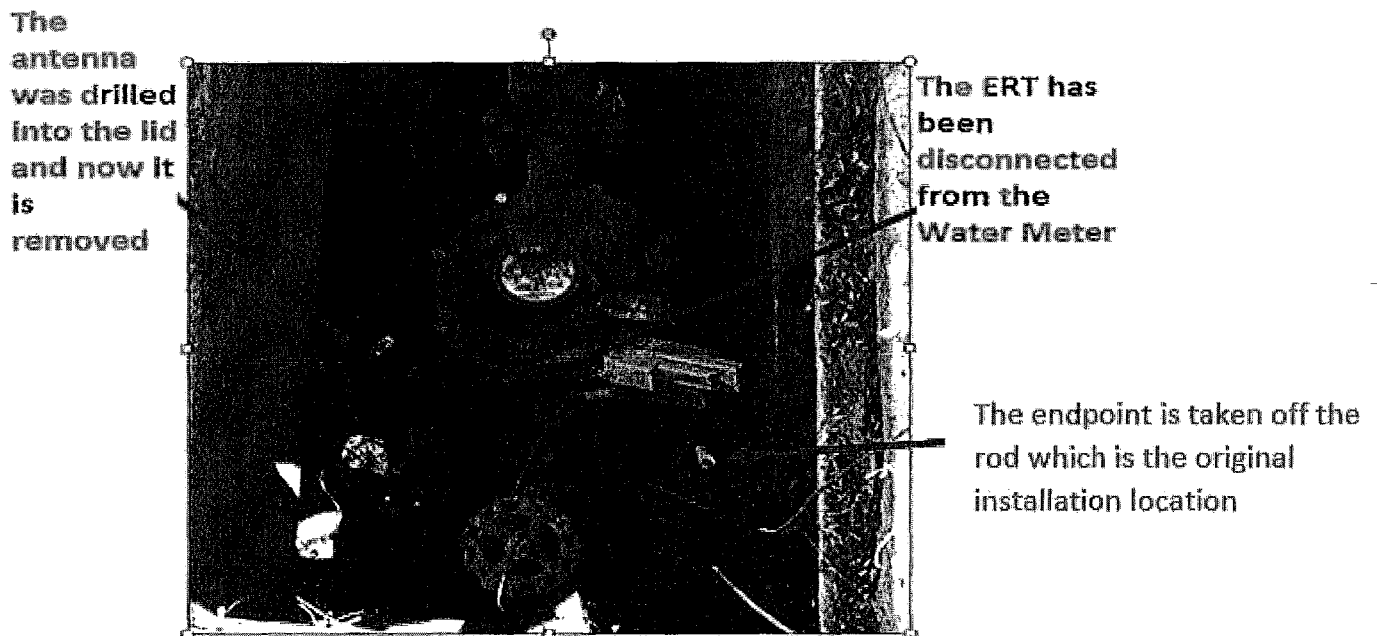


Photo 6 below is an example of disturbance that shall be avoided:

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:

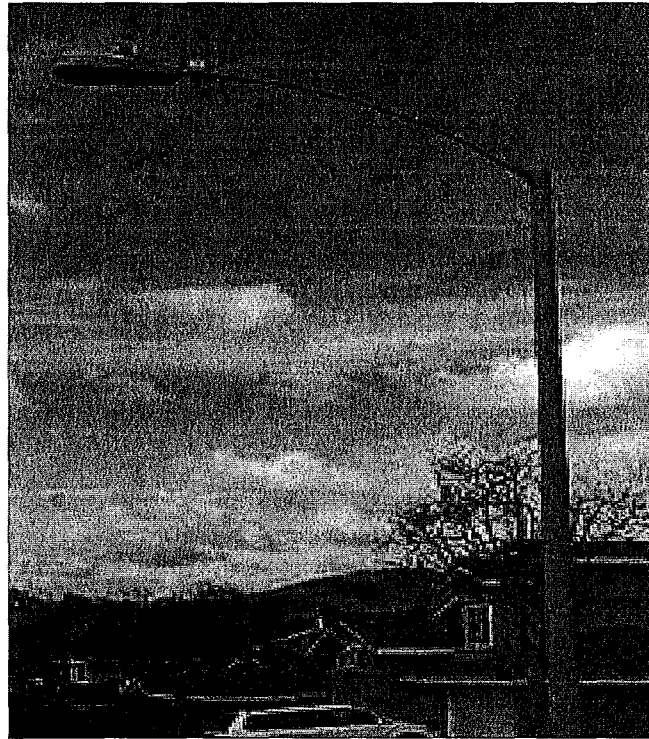
Photo 7



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.**

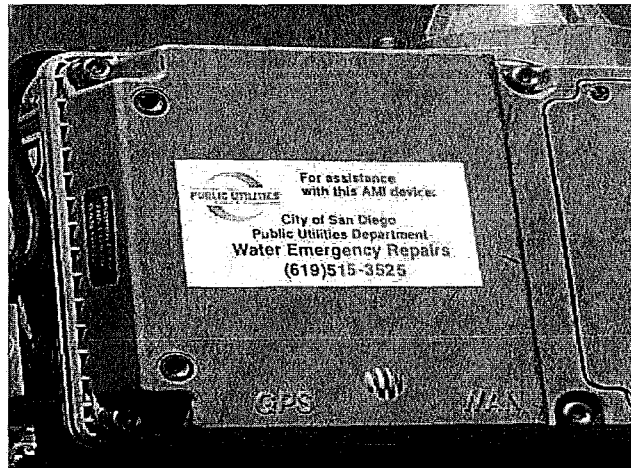
Photo 8 shows an installed network device on a street light. On the back of each Network Device is a sticker with contact information. See Photo 9. **Call PUD Water Emergency Repairs at 619-515-3525 if your work will impact these street lights.** These are assets that belong to the City of San Diego 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.

ATTACHMENT F
INTENTIONALLY LEFT BLANK

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 Co., herein called "Contractor" for construction of **La Jolla Country Club Reservoir and Pump Station**; Bid No. **K-17-1191-DBB-3**; in the amount of **Six Million Two Hundred Eighty-Six Thousand Four Hundred Sixty Dollars and Zero Cents (\$6,286,460.00)**, 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:

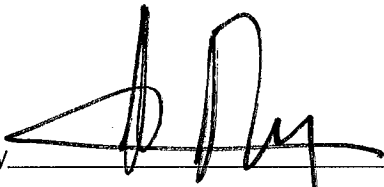
1. The following are incorporated into this contract as though fully set forth herein:
 - (a) The attached Faithful Performance and Payment Bonds.
 - (b) The attached Proposal included in the Bid documents by the Contractor.
 - (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).
 - (d) That certain documents entitled **La Jolla Country Club Reservoir and Pump Station**, on file in the office of the Document No. **B-11024**, 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 **La Jolla Country Club Reservoir and Pump Station** ; Bid No. **K-17-1191-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.

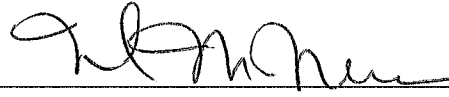
CONTRACT AGREEMENT (continued)

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

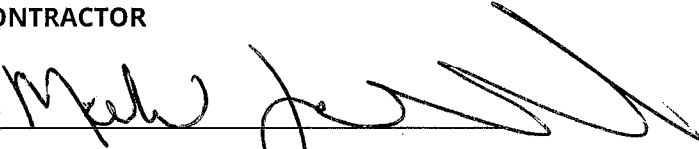
By 
Print Name: Albert P. Rechany
Deputy Director
Public Works Department

Mara W. Elliott, City Attorney
By 
Print Name: Mark M. Meroee
Deputy City Attorney

Date: 10/5/17

Date: 10/6/17

CONTRACTOR

By 
Print Name: Mark Jennette
Title: President
Date: 6/19/2017

City of San Diego License No.: B2004016715

State Contractor's License No.: 897555

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000002089

CERTIFICATIONS AND FORMS

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

Bidder's General Information

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

**NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID
UNDER 23 UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106**

State of California

County of San Diego

The bidder, being first duly sworn, deposes and says that he or she is authorized by the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 7-13.3, "Drug-Free Workplace", of the project specifications, and that;

This company has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

AMERICAN WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the American With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 7-13.2, "American With Disabilities Act", of the project specifications, and that:

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 7-13.4, ("Contractor Standards"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors whose subcontracts are greater than \$50,000 in value has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

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.

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:

LA JOLLA CLUB RESERVOIR AND PUMP STATION

(Name of Project)

as particularly described in said contract and identified as Bid No. **K-17-1191-DBB-3**; SAP No. (WBS/IO/CC) **B-11024**; and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

_____ Contractor

by

ATTEST:

State of _____ County of _____

On this _____ DAY OF _____, 2_____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared _____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

LIST OF SUBCONTRACTORS

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION**

In accordance with the requirements of the "Subletting and Subcontracting Fair Practices Act", Section 4100, of the California Public Contract Code (PCC), the Bidder is to list below the name, address and license number of each Subcontractor who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement, in an amount of or in excess of 0.5% of the Contractor's total Bid. Failure to comply with this requirement may result in the Bid being rejected as non-responsive. The Contractor is to list only one Subcontractor for each portion of the Work. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3 Subcontracts, which stipulates the percentage of the Work to be performed with the Bidder's own forces. The Bidder is to also list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which the Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	CONSTRUCTOR OR DESIGNER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK	DOLLAR VALUE OF SUBCONTRACT	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR 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	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 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 as Principal, and
A, San Diego, CA 92126
Arch Insurance Company, 99 High St., as Surety, are
8th Floor, Boston, 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

La Jolla Country Club Reservoir and Pump

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 11th day of April, 2017

NEWest Construction Co., Inc(SEAL)

Arch Insurance Company (SEAL)

(Principal)

(Surety)

By: 

By: 

(Signature)

Donna M. Robie, Attorney-in-Fact
(Signature)

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

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."

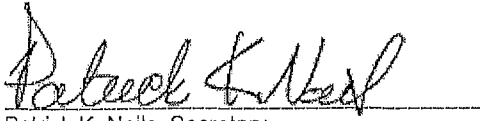
This Power of Attorney is signed, sealed and certified by facsimile under and by authority of the following resolution adopted by the unanimous consent of the Board of Directors of the Company on September 15, 2011:

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.

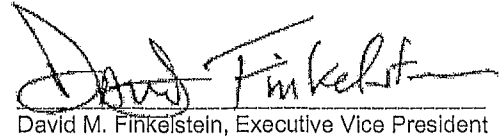
In Testimony Whereof, the Company has caused this instrument to be signed and its corporate seal to be affixed by their authorized officers, this 21st day of June, 2016.

Attested and Certified

Arch Insurance Company


Patrick K. Nails, Secretary

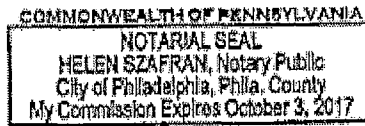


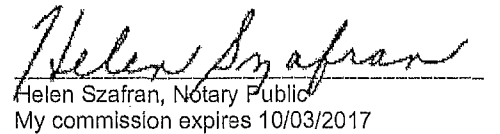

David M. Finkelstein, Executive Vice President

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.

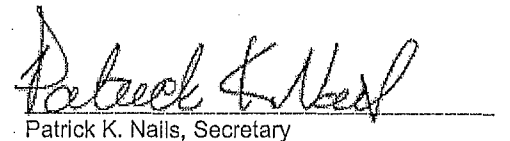



Helen Szafran, Notary Public
My commission expires 10/03/2017

CERTIFICATION

I, Patrick K. Nails, Secretary of the Arch Insurance Company, do hereby certify that the attached Power of Attorney dated June 21, 2016 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.

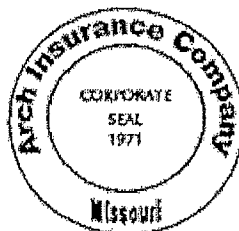
IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seal of the Arch Insurance Company on this 11th day of April, 2017.


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:

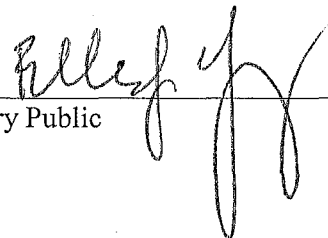
Arch Insurance – Surety Division
3 Parkway, Suite 1500
Philadelphia, PA 19102



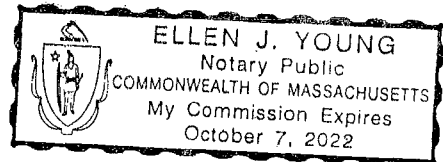
SURETY ACKNOWLEDGMENT

State of: Massachusetts
County of: Middlesex

On this 11th day of April, 2017 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



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.

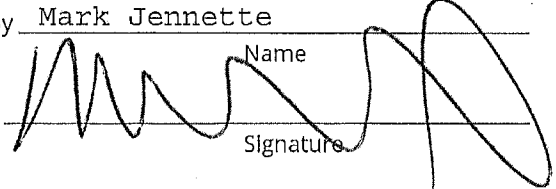
- The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.

- 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 5/17/17

USE ADDITIONAL FORMS AS NECESSARY

City of San Diego

CITY CONTACT: Angelica Gil, Contract Specialist, Email: AngelicaG@sandiego.gov
Phone No.: (619) 533-3622, Fax No.: (619) 533-3633

ADDENDUM "B"

 **e - Bidding** FOR



LA JOLLA COUNTRY CLUB RESERVOIR AND PUMP STATION

BID NO.:	<u>K-17-1191-DBB-3</u>
SAP NO. (WBS/IO/CC):	<u>B-11024</u>
CLIENT DEPARTMENT:	<u>2000</u>
COUNCIL DISTRICT:	<u>1, 6</u>
PROJECT TYPE:	<u>BJ, BK</u>

BID DUE DATE:

**2:00 PM
MAY 17, 2017
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101**

ENGINEER OF WORK

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

Gail K. Masutani
1) Registered Engineer/Architect

5/1/17
Date

Seal:



Debbie M. Van Martin
2) For City Engineer

5/1/2017 Seal
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.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. BIDDER'S QUESTIONS

- Q1. Please provide the SDCWA Std. Dwg SD-10 for the Saf-T-Climb ladders per drawing C-8.
- A1. Revise the note "5'x5' BILCO ACCESS HATCH IN RESERVOIR ROOF WITH SAF-T-CLIMB LADDER PER SDCWA SD-10. LADDER DETAIL 1, TWO PLACES" to "5'x5' BILCO ACCESS HATCH IN RESERVOIR ROOF. THE LADDER SHALL BE PROVIDED WITH INSTALLED SAFETY CLIMB RAIL AND HARNESS EQUIPMENT, AND A LADDER WITH A RETRACTABLE UP-POST OR SAFETY POST THAT EXTENDS 3 FEET ABOVE THE LADDER FOR SAFE ACCESS. UNIT SHALL BE AS MANUFACTURED BY BILCO OR APPROVED EQUAL."
- Q2. Where can I obtain a copy of the soils report for the above referenced project?
- A2. Refer to Filecloud site: <https://filecloud.sandiego.gov/url/rsj3ayurc35o>
- Q3. Can you consider the UGSI Tank Shark mixer product as an "equal" for the Mixer spec called out in Section 11220?
- A3. We will not approve this as "an equal". The Tank Shark does not appear to provide the required sample volume as stated the specifications. The website and attached project profile indicated 10 gphr, whereas Specification Section 11220 2.1.B indicates minimum volume of 15 gphr.
- Q4. Sht. I-2 calls out a Chlorine Analyzer, (AE/AIT 04). This equipment is also shown on the Electrical and Civil drawings. Please provide Specifications for this equipment
- A4. Specification has been attached as pages 15 through 17 of this Addendum.
- Q5. Can we place the crane on top of the reservoir floor slab during construction of the walls and roofs? We plan on using a 50-60 TN RT Crane if we can place it on the floor. It will be a very big crane and not cost-effective if we put one outside the tank excavation.
- A5. There is a possibility that a crane can be placed within the reservoir during construction. However, a determination cannot be made until the Contractor's method of supporting the crane is provided for review.

- Q6. The project only has 360 working days. Based on our experienced on similar projects, the project needs additional time. Please add additional 40 working days on the project duration. With the tight site, the major activities will be done one after the other. Initial work includes the bypass line and valves, which will require time for submittals and delivery lead time. Also, work will not be as productive compare to wide open site. Pump Station building cannot be constructed until the tank is tested and backfilled.
- A6. The project duration will be 400 working days.
- Q7. Please provide copy of the hazardous material testing report.
- A7. Refer to Filecloud site: <https://filecloud.sandiego.gov/url/rsj3ayurc35o>
- Q8. Is it the intent of the spec to coat the concrete inside the reservoir? What about the roof (interior and exterior).
- A8. See Specification 07160 – Crystalline Waterproofing for the interior of the reservoir. The interior wall and roof shall be coated. There will be no coating on the roof of the reservoir.
- Q9. Sheet C-4 – Please provide as built of the existing reservoir and information of the 3" TK liner.
- A9. Refer to Filecloud site: <https://filecloud.sandiego.gov/url/rsj3ayurc35o>
- Q10. Sheet C-8 – Please provide clarification of notes 3 & 4. Note 3, is not clear because there is no temporary piping shown or sequencing. Note 4 is similar.
- A10. Notes 3 and 4 refer to the connection of the existing piping to the new pipes. The "Bypass" pipes are not temporary, they are permanent pipes. The bypass pipes should be one of the first items to be installed for this project to allow the supply of water through the existing 12" ACP.
- Q11. Sheet C-8 – the 12" zone 725HGL at the Altitude Vault shown on M-2. Does it require bypass piping or can it be cut and capped at start of construction?
- A11. Provide by-pass piping.
- Q12. Page 924 of Ebid documents – bird season is Feb1 to Sept 15. Since trees will be impacted and construction noise will be significant, will the working days begin on Sept 16th?
- A12. Yes, starting work would avoid nesting birds, but a biologist is still required to assist in flagging individual native plant species for avoidance.

- Q13. There is specs for cathodic protection 16640 but the plans does not show any. If required, please provide drawings showing locations and details.
- A13. The mechanical plans indicate where insulating flange kits are required and see Note 3 on Dwg M-3.
- Q14. With regards to shoring of the reservoir excavation. The shoring on the North Side will be deeper and will require underground tie-backs due to the reservoir outlet pipe depth. The shoring tie-backs will pass through the property line and will enter the neighbor property. Please confirm that the City has easement for this tie-backs and make sure that the property owner is aware of this.
- A14. Tie-backs will not be allowed and are not required. See geotechnical investigation. (See page 18 of this Addendum)
- Q15. Please confirm that the City will drain the existing reservoir prior to our demolition work.
- A15. The temporary bypass should be installed by the contractor before the City drains the system.
- Q16. Per Noise Notes on C-3. If construction noise exceeds the ordinance limits, the contractor shall erect sound attenuation barriers. Will this be a Change Order if it happens? It's impossible to quantify at bid time as to what type and how much of Noise Barrier you would need unless you have a prior knowledge of the anticipated construction noise.
- A16. The City's noise ordinance is referenced in the contract documents, and Contractor shall apply appropriate measures to comply with the requirements.
- Q17. Please provide more information on the vertical pump requirements such as pump data sheets. (Already answered in addendum)
- A17. Pump data sheets were provided in Addendum No. 1 for the vertical turbine pumps. The pump data sheet for the submersible pump, see page 19 of this Addendum.
- Q18. Please confirm that we use all the areas within the property line during construction.
- A18. Contractor should use all areas within the city's property within the project limits to the extent that is feasible.

- Q19. Please provide the type of block wall in the pumps station (split face, precision, etc...).
- A19. Per Section 04232 Subsection 2.1.B the masonry units are split face.
- Q20. Please provide sectional detail and elevation of the footing and wall of reservoir on section S-S shown on the plan on Drawing S-9.
- A20. No detail is required. The S-S denotes a step footing and shows its location. It's the Contractor's responsibility to determine how the footing is stepped based on the requirements provided in typical detail 6/S-5.
- Q21. Please provide drawing of the Generator.
- A21. See Specification Section 16200 Subsection 2.1.C for make and model of generator.
- Q22. Drawing C-3 calls out the access road up to the site as 3"AC over 5" AB. But drawing C-15 shows the same access road as permeable pavers. Please specify which method is correct.
- A22. The paving over the access road shall be permeable pavers as shown in dwg C-15.
- Q23. **Section 9800 - Protective Coating Section:**
- a) Section 1.1.C - Indicates the following surfaces shall not be protective coated unless specifically indicated in other Sections or on the Drawings.
- Concrete.
- b) Section 2.5 - Coating system schedule to provide protective coatings for the above grade or below grade concrete, submerged and non-submerged, and below grade concrete, submerged, potable water.
- Proposed modifications shall be presented individually in writing to the RESIDENT ENGINEER for consideration during the design phase and upon acceptance by the RESIDENT ENGINEER shall be included in the CONTRACT DOCUMENTS.
- Does all concrete placed onsite require an epoxy concrete coating?**
- A23. Only the interior of the reservoir require epoxy coating.
- Q24. Spec. Section 11033, (Variable Frequency Drives) 2.1 B calls for the manufacturer to be Toshiba A51 or approved equal. Are the following manufacturers approved - (Eaton, Robicon, ABB, Sq-D)?
- A24. Submittal can be made for alternative equipment per the substitution process. The equipment must fit the space provided for the VFD. No building alterations will be accepted to accommodate VFDs.

- Q25. Section 07160 Part 3.3, C. 1 & C.2. - Please confirm that this is either a one coat or two coat application.
- A25. Provide two coats.
- Q26. Section 9900 - Although Architectural systems are specified, there are no specific system listed for what appears to be an exposed wood ceiling w/acoustical panels in the pump room #102 and electrical room #101. Please confirm the surfaces and what they are painted with.
- A26. The intent is to have the interior structural wood framing surfaces exposed with no finish required and only the acoustical panels having finished surface (Spec section 09843 stated the acoustical panels are to be shop-fabricated and fabric-wrapped.)
- Q27. After review of section 8170 and xypex guide specifications and product data, please clarify the following; 1. Clarify that this is either 1 or 2 coat system. 2. Clarify the surfaces requiring application, i.e. floor, walls and ceiling or just the walls, not floor etc.
- A27. Provide two coats, per section 07160. All interior surfaces of the reservoir shall be coated including the roof.
- Q28. Doors and Frames Dwg A-1 lists 5 doors being "prefinished", Section 8110, Par. 2.9 A "Factory - Applied Paint Finish and then in 3.2 B. suggests they are only Prime painted prior to installation. Please clarify if these doors and frames are Factory finished or Factory primed and field finished.
- A28. Factory applied finish per the plan and spec. Spec section 08110 par 1.1 A, par 2.9 noted the finishes to be factory applied.
- Section 3.2 "Adjusting and Cleaning" par B is intended for any touch up that may maybe needed when the door finish is damaged during construction for damaged areas.*
- Q29. Addendum A addressed the TDH for P-01, P-02, & P-03. However, the TDH for P-05 has not been provided nor has a data sheet been provided. Please provide the information on this item.
- A29. See attached information for P-05.
- Q30. Sheet C-8 calls out 6" perforated subdrain collector pipe, see sheet C-3. Sheet C-3 and detail 1/C-4 shows this same pipe as 4" perforated. Please advise.
- A30. The subdrain pipe is 6-inches as shown in C-8 and should be 6-inches in C-3. The Section A/C-4 depicts the 4-inch underdrain connecting to the two 6-inch perforated pipes as shown in C-8. The detail A/C-4, shows a 4-inch subdrain along the exterior-side of the reservoir wall.

Q31. **Surveillance Security System**

Question: Specifically, on page 60(J) (and other parts of the document) of the Solicitation (as you referred to as the Contract Documents) it mentions "Surveillance Security System, however there are no information of security items of any kind, on the drawings. Most Pump Stations have some type of security, and need to see if there might be other drawings, not included in the package that speak to this.

- A31. Bid item will be an Allowance provided to coordinate the determination of the required materials and design with the City Resident Engineer and City's Consultant, and including to furnish, and install and all equipment as required.

Contractor to allow for up to 5 security cameras (panning and/or zoom and Infrared illumination and/or thermal), each with poles equipped for 110-volt power, all 1-inch power and communications conduits on dedicated circuit as required, UPS, Network Video recorder and security sensors and switches, Telco backboard for access control panel and power supplies, vertical locking rack, and any wireless capabilities as required.

- Q32. C-15 - the depth of the permeable base will require the 12"ACP line to be exposed. The line would have to be de-energized and which is not addressed in the specifications. Also the ACP line be exposed to construction loads during construction and un-even loading post construction. For the above reasons we feel the permeable base design will be impact the current and future service life of the 12ACP water main.

- A32. Contractor shall protect and maintain existing pipelines during construction to the extent possible.

C. CLARIFICATIONS

1. The FTP weblinks provided in the Supplementary Special Provisions are not valid. Find the documents listed in 2-7, Subsurface Data (page 31) and 2-15, Technical Studies and Data (page 32) at this filecloud weblink:

<https://filecloud.sandiego.gov/url/rsj3ayurc35o>

D. ATTACHMENTS

1. To Attachment A, Scope of Work, page 21, Item 4, Contract Time, **DELETE** in its entirety and **SUBSTITUTE** with the following:
- 4. CONTRACT TIME:** The Contract Time for completion of the Work, including the Plant Establishment Period, shall be **400 Working Days**.

2. To Attachment B, Phased Funding Provisions, pages 23 through 24, **DELETE** in their entirety and **SUBSTITUTE** with pages 12 through 13 of this Addendum.

3. To Attachment E, Supplementary Special Provisions, **ADD** the following:

7-8.6.5 Hydrostatic Discharge Requirements. To the "WHITEBOOK", ADD the following:

2. **Chlorination Discharge Requirements.**

a) If a 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 per the contract documents after de-chlorination as shown on the "Chlorination Discharge Locations Plans". You shall submit to the Engineer a "Request for Batch Discharge Authorization to Discharge Potable Pipe Flushing Water to Sewer". The request form can be found on the City website:

<https://www.sandiego.gov/mwwd/environment/iwcp/batch>

b) When discharging to the sewer system, you shall use a totalizer flow meter to record the total volume discharged to sewer and 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 5 Working Days of the discharge, the Engineer shall report actual total flows to the sanitary sewer to PUD, Industrial Wastewater Control Program (IWCP).

c) If discharge to sewer system is not approved, you shall discharge the chlorinated water used for testing of new mains to surface water, storm drain inlets, or other approved methods and you shall comply with Section 7-8.6.5 Hydrostatic Discharge Requirements. 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 (NAPDS No. CAG140001) as referenced by:

http://www.waterboards.ca.gov/water_issues/programs/npdes/general_permits.shtml

- d) All testing shall be conducted by a Qualified SWPPP Practitioner (QSP).
4. To Attachment E, Supplementary Special Provisions, **ADD** the following:
- 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".
5. To Attachment E, Supplementary Special Provisions, Technicals, **ADD "Section 13345, Chlorine Residual Analyzer"**, pages 15 through 17 of this Addendum.
6. To Attachment E, Supplementary Special Provisions, Technicals, Section 01025, Measurement and Payment, page 62, Subsection 3.3., Bid Items, **ADD** the following:
- U. SDG&E TRANSFORMER AND SWITCHBOARD RELOCATION - Lump Sum Bid Item shall include full compensation for all equipment, materials, and labor to install the SDG&E transformer and switchboard in the location described. (See Exhibit attached in this Addendum). The Price for the Bid Item shall include all work related to, coordination with City/SDG&E, protection or removal of existing landscaping as required, clearing and grubbing, demolition of existing retaining/planter walls, excavation, grading, and all preparation for installation of concrete pads, installing the transformer and switchboard, conduits, ductbanks, and replacement of any landscaping/ground cover in kind, pavement restoration, and also replacement of the existing retaining/planter wall in kind as in prior condition, and all other accessories required. All work shall be coordinated with the City's Resident Engineer/Construction Manager according to SDG&E standards.
7. To Attachment E, Supplementary Special Provisions, Technicals, Section 01025, Measurement and Payment, page 60, Subsection 3.3., Bid Items, Item J, Surveillance Security System, **DELETE** in its entirety and **SUBSTITUTE** with the following:
- J. SURVEILLANCE SECURITY SYSTEM - Allowance Bid Item shall include full compensation for all equipment, materials, and labor to install the security system as shown in the CONTRACT DOCUMENTS. The Price for this Bid Item shall include all work related to cameras, card

readers, swing gate opener, vehicle detector, magnetic gate locks, mounting posts, camera mounting poles, conduits, SCADA interface, and all other accessories as indicated in the CONTRACT DOCUMENTS.

8. To Attachment E, Supplementary Special Provisions, Appendices, Appendix F, Hydrostatic Discharge Form, page 969, **DELETE** in its entirety and **SUBSTITUTE** with pages 20 through 21 of this Addendum.

E. ADDITIONAL CHANGES

1. The following are additional changes to the Line Items in the PlanetBids Tab:

For clarity where applicable, **ADDITIONS**, if any, have been **Underlined** and **DELETIONS**, if any, have been **Stricken out**.

Section	Item Code	Description	UoM	QTY	Payment Reference	UnitPrice
Main Bid	<u>541820</u>	<u>Exclusive Community Liaison</u>	<u>LS</u>	1	<u>7-16-4</u>	
Main Bid	<u>238210</u>	<u>SDGE Transformer & Switchboard Relocation</u>	<u>LS</u>	1	<u>01025-3.3U</u>	
Main Bid	238210	Surveillance Security Systems <u>Surveillance Security Systems – (EOC Type I)</u>	LS <u>AL</u>	1	01025-3.3J	<u>75000</u>

James Nagelvoort, Director
Public Works Department

Dated: May 2, 2017
San Diego, California

JN/JB/egz

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 22 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

NOTE: THIS IS A SAMPLE PHASED FUNDING SCHEDULE AGREEMENT FORM.

The particulars left blank in this sample, such as the total number of phases and the amounts assigned to each phase, will be completed with funding specific information from the Pre-Award Schedule and Construction Cost Loaded Schedule submitted to and approved by the City.

BID NUMBER: _____

CONTRACT OR TASK TITLE: _____

CONTRACTOR: _____

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1				\$
2	<u>All Additional phases to be added</u>			
	<u>to this form as necessary.</u>			
Contract Total				\$

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: _____

PRINT NAME: _____

Construction Manager

Signature: _____

Title: _____

Date: _____

Signature: _____

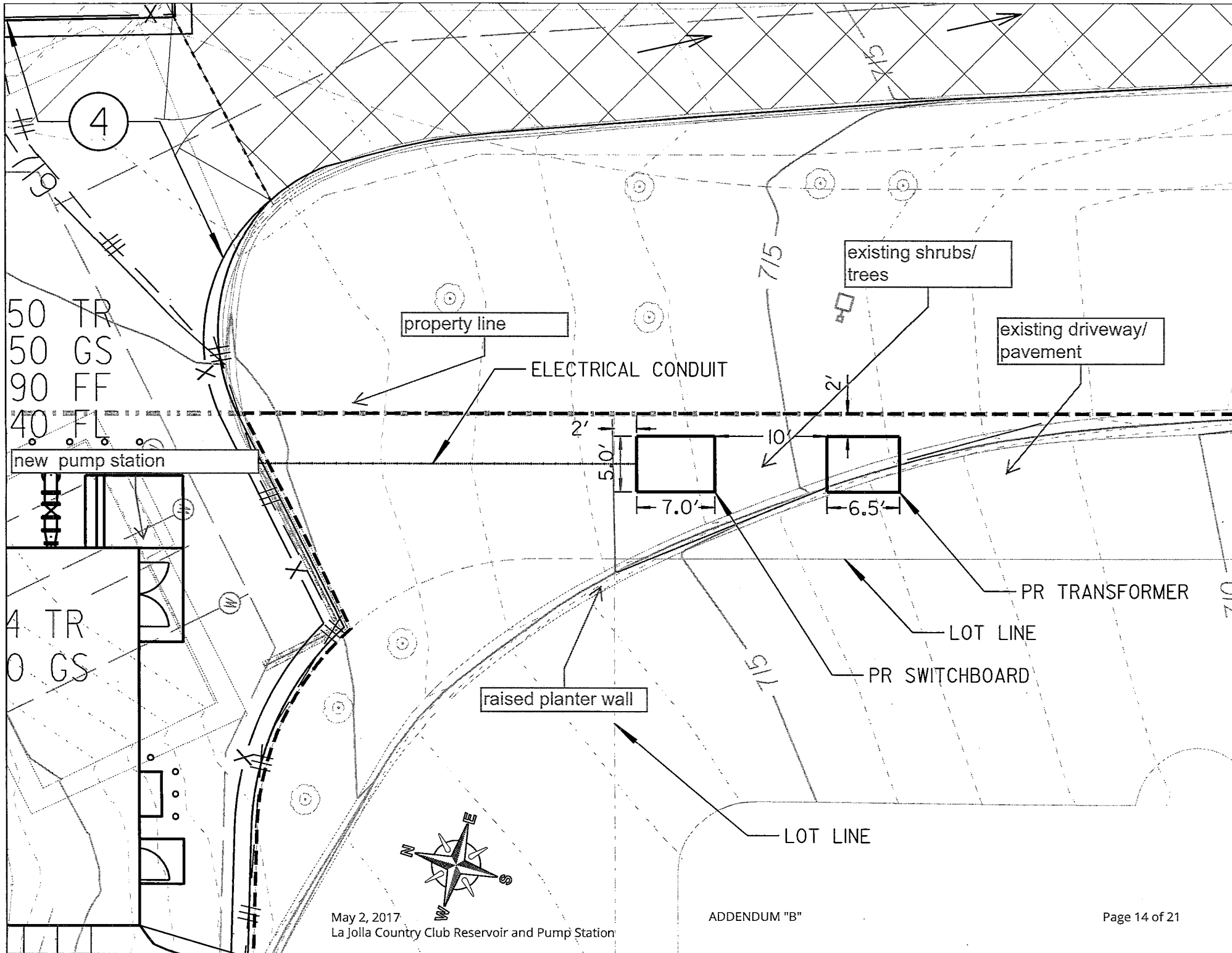
PRINT NAME: _____

Date: _____

Project Manager

Signature: _____

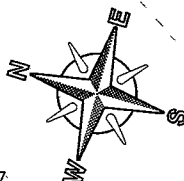
Date: _____



50 TR
 50 GS
 90 FF
 40 FL

new pump station

4 TR
 0 GS



SECTION 13345 – CHLORINE RESIDUAL ANALYZER

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. General: The CONTRACTOR shall provide chlorine residual analyzer and controller, complete and operable, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 13300 Instrumentation and Controls
 - 2. Section 15000 Piping Components

1.3 CONTRACTOR SUBMITTALS

- A. Shop drawings shall be submitted in conformance with the requirements of Section 01300 - Submittals and Section 13300 - Instrumentation and Controls.

PART 2 -- PRODUCTS

2.1 CHLORINE RESIDUAL ANALYZER

- A. The analyzer shall be designed for continuous measurement of the sample stream without the need for reagent addition and consist of the following measurement: Free chlorine, total chlorine, and pH. The free chlorine measurement shall be amperometric by way of a bare electrode flow cell with hydro-mechanical cleaning. An integral multi-sensor shall provide temperature measurement and shall monitor sample flow to provide a loss of flow alarm contact. Up to four measurements shall be analyzed within a single flowcell and displayed on the electronics. The continuous measurement shall include: a measurement specific sensor, a sensor cable and a pre-calibrated sensor input card specific to the measurement chosen. The sensors shall be housed in a molded clear plastic flow cell. The measuring cell enclosure shall be IP 66 (designed to meet NEMA 4X)
- B. The flow cell shall have built in:
 - 1. A sample flow control device
 - 2. A flow check valve
 - 3. A sample flow alarm device
 - 4. A sample flow temperature probe
 - 5. A built-in mesh filter screen to remove large debris in the sample water
- C. Required features:
 - 1. Free chlorine measurement – Depolox® 5 Bare electrode Cell - Amperometric measuring principle with hydro-mechanical cleaning of the electrodes:

- a) Measurement ranges 0 – 5.00 mg/l
- b) Accuracy: 10 µg/l or ±2% of full scale
- c) Sensitivity: 10 µg/l or ±1% of full scale
- d) Repeatability: 10 µg/l or ±2% of full scale
- e) Stability: 2% of full scale per month
- f) Response Time: 90% of change within 20 seconds of sample entry
- g) Sampling rate continuous @ 550 ml/min
- h) Inlet pressure of flowcell: 3 to 60 psig
- i) Inlet sample temperature: 41 to 122 degrees Fahrenheit

2. Combined hydrogen ion selective and reference electrodes:

- a) Measurement range 0 to 1000 mV
- b) Measurement sensitivity: 1 mV
- c) Scaled in 100 mV increments
- d) Sampling rate continuous @ 550 ml/min
- e) Inlet pressure of flow cell: 3 to 60 psig
- f) Inlet sample temperature: 41 to 104 degrees Fahrenheit

2.2 CONTROLLER

- A. Controller shall be a wall surface mounting in a suitable IP 66 (designed to NEMA 4X) enclosure. The controller functionalities of the instrument shall be microprocessor based and capable of sending 4-20 mA signals proportional to chlorine and pH measurements. The controller shall transmit proportional analog signal to PLC.
- B. The instrument shall have an LCD graphic display with seven display configurations which can be changed via the up and down arrow of the touch pad. The graphical display shall be able to show the historical measurement readings of up to seven days, by scanning back and forwards in time in six hour intervals. The instrument shall incorporate 8 alarm or contact LED's as well as a power ON LED.
- C. The instrument shall incorporate eight (8) fully configurable relays,
- D. The controller shall be built in accordance to CE, UL and CSA standards and shall be certified to these standards.
- E. Power: 115 Vac, 60 Hz, single-phase
- F. Manufacturers:
 - 1. Evoqua; Depolox 5 Bare Electrode with pH sensor; Evoqua MFC-Depolox 5 Multi-function controller,
 - 2. Or approved equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Chlorine residual analyzer and controller shall be executed according to Section 13300 - Instrumentation and Control.

**** END OF SECTION ****

personnel are allowed to enter the excavation. Any zones of potential instability, sloughing or raveling should be brought to the attention of the Engineer and corrective action implemented before personnel begin working in the excavation.

Shoring will be needed along the west side of the planned reservoir. Recommended earth pressure values for the design of the cantilever shoring (soldier piles and lagging and sheet piles without tie-back anchors) are shown on Figure 4. The surcharge loads on shoring from construction equipment working adjacent to the excavation can be modeled by assuming an additional two feet of soil behind the wall. SCS&T should be notified if other surcharge loads are anticipated so that lateral load criteria can be developed for the specific situation.

Excavated materials should not be stockpiled behind temporary shoring within a distance equal to the depth of the excavation.

Existing fill and very old paralic deposits should be classified as Type C soils in accordance with CalOSHA guidelines. The formational materials can be considered Type B.

5.1.3 Site Preparation – Reservoir

Site preparation should begin with the demolition of the existing reservoir followed by removal of the debris. It is expected that formational material will be exposed at the planned reservoir elevation bottom. An SCS&T representative should observe conditions exposed at the bottom of the excavation to determine if additional excavation is required.

Existing fill, wet soil or other unsuitable material encountered at the bottom of the excavation should be excavated in their entirety. The excavated material should be replaced with three-sack sand/cement slurry or lean concrete.

5.1.4 Site Preparation – Pump Station

Site preparation should begin with the removal of vegetation and debris. It is expected that a portion of the pump station will be within the back cut required for the construction of the reservoir. To minimize the potential for differential settlement, remedial grading should be performed.

The existing soil should be excavated to a depth of 3 feet below the planned footing bottom elevation. Additionally, the existing fill, if any, should be excavated in its entirety. It is expected that the excavation will extend about 5 feet below the existing ground surface. Horizontally, the excavation should extend at least 5 feet outside the perimeter footings or up to the existing improvements, whichever is less. A SCS&T representative should observe



SUBMERSIBLE PUMP DATA SHEET, 11209-01

Tag Numbers: P-05

Pump Name: Sump Pump

SERVICE CONDITIONS:

Liquid Pumped: Potable Water

Pumping Temperature (Fahrenheit): Normal 60 Max 85 Min 40

Specific Gravity at 60 Degrees F: 1.0

Abrasive (Y/N): N Possible Scale Buildup (Y/N): Y

Min. NPSH Available (Ft. Absolute): 33

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 500

Total Dynamic Head (Ft): Rated: 20

Maximum Shutoff Pressure (Ft): Rated: _____

Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): _____

Max. Pump Speed at Rated Capacity (rpm): 1750

Constant (Y/N): Y

Adjustable (Y/N): N

DRIVE MOTOR (See Section 16040, Electric Motors.)

Horsepower: 5 Voltage: 460 Phase: 3 Synchronous Speed (rpm): 1750

Other Features: _____

Moisture Detection Switches (Y/N): Y

Thermal Protection Embedded in Windings (Y/N): Y

REMARKS: _____

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 <small>*report discharge exceedances to the RE immediately and complete attached Monitoring Exceedance Form</small>		
				Measurement	Unit	Time	Result		No	Yes			
1	<u>Location</u>	<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 <small>(estimate)</small>	gal	Diverted		<div style="border: 1px solid black; width: 100%; height: 100%; display: flex; align-items: center; justify-content: center;"> X </div>					
	gal				To Sewer								
	gal				To Storm Drain								
	gal				Total								
	Chlorine <small>(Minimum samples first 10, first 60, and last 10 minutes)</small>			<u>Start Date</u>			mg/L				0.1 mg/L =Exceedance		
Turbidity <small>(Minimum samples first 10, first 60, and last 10 minutes)</small>	<u>Start Time</u>			NTU				20 NTU =Exceedance for Surface Waters					
PH <small>(Minimum samples first 10, first 60, and last 10 minutes)</small>	<u>End Time</u>			Units				225 NTU = Exceedance for Ocean					
Additional Samples (Chollas Creek Only)	<u>End Date</u>				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	6.0 to 9.0
>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	6.0 to 9.0
	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

City of San Diego

CITY CONTACT: Angelica Gil - Contract Specialist, Email: AngelicaG@sandiego.gov
Phone No. (619) 533-3622, Fax No. (619) 533-3633

ADDENDUM "A"

 **e - Bidding** FOR



LA JOLLA COUNTRY CLUB RESERVOIR AND PUMP STATION

BID NO.:	<u>K-17-1191-DBB-3</u>
SAP NO. (WBS/IO/CC):	<u>B-11024</u>
CLIENT DEPARTMENT:	<u>2000</u>
COUNCIL DISTRICT:	<u>1, 6</u>
PROJECT TYPE:	<u>BJ / BK</u>

BID DUE DATE:

2:00 PM

MAY 11, 2017

CITY OF SAN DIEGO

PUBLIC WORKS CONTRACTS

**1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101**

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. CLARIFICATION

1. For Section 2-15 Technical Studies and Data, use the following link provided:

<ftp://ftp.sannet.gov/OUT/ECP/2-7%20SUBSURFACE%20DATA/La%20Jolla%20Country%20Club%20Reservoir%20and%20PS/>

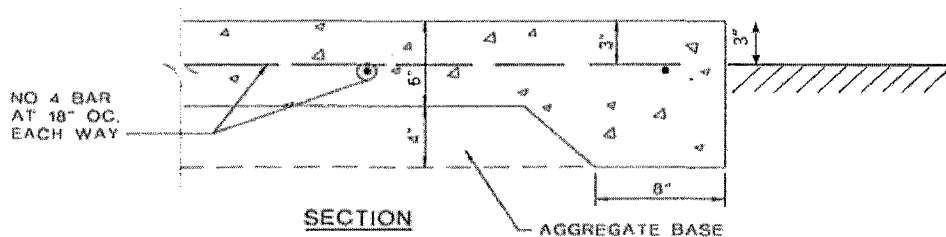
C. BIDDER'S QUESTIONS

- Q1. How thick is the generator slab shown on C-3?

A1. The Contractor shall provide the structural design for the generator. The structural calculations for the generator shall be signed and stamped by a civil or structural engineer registered in the State of California

- Q2. Please provide details for the three stoops at the Pump Station.

A2.



CONCRETE LANDING

1. Provide ½-inch urethane caulking between landing and building pad.
2. Two landings are 4'0" x 4'0", one landing is 4'0" x 8'4".

Provide ½-inch urethane caulking between landing and building foundation

Q3. Is detail 3 on S-5 used for floor construction joints at the pump station and detail 6 on S-8 used for ALL the four slab construction joints in the reservoir?

A3. Yes.

Q4. Find the data sheets for the vertical turbine pumps?

A4. The data sheets for the vertical turbine pumps. Refer pages 6 through 9 of this Addendum.

Q5. Attached sheet page references (Section 11214 Section 3.2) the data sheets for the pumps but I'm having trouble finding them in the specifications.

A5. See response to A4.

Q6. Section 11033 – Variable Frequency Drives 2.1B (page 575) indicates the VFD product as "Toshiba A51, or approved equal". I think the "A51" is a typo and want to confirm that it should actually read "AS1". Please confirm.

A6. Section 11033 Subsection 2.1.B. Revise "Toshiba A51" to "Toshiba AS1".

Q7. Section 16412 – Automatic Transfer Switches 2.1A (page 849) indicates "Transfer switch to be provided by the low voltage motor control center manufacturer." Can we take exception to this specification and quote using ASCO or GE Zenith automatic transfer switch? Please confirm

A7. No changes to the specification.

Q8. In spec 10520 2.2 there are three different types of fire extinguishers called out. In the pump station there are two places called out for extinguishers, what type of extinguishers do you want in the electrical room and pump room? Are cabinets required?

A8. Type C (primary electrical fires) should be for the Electrical room and Type B (primary liquid fires) for the Pump room. Cabinets are not

required, unless deemed necessary by the Owner for protection of fire extinguishers.

- Q9. Spec 08110 is for steel doors and frames, on drawing A-1 note 2 is calling out for acoustical door and frame. Please confirm what kind of doors are necessary. Some doors are calling out a 20 minute rating. Is this for fire?
- A9. For Door 102B provide steel, acoustical door and frame per section 08112. Yes, the rating is required as noted.
- Q10. Section 07810 - The specifications are describing a dome style skylight with acrylic glazing. This description does not match the architectural plans (Sheet A-2 Skylight Schedule) which are showing a single dome skylight. The ICC report ESR-1253 is for the Skylights shown on the plans and not as described in the specifications. Confirm which is the correct type of skylight.
- A10. The two requirements for the Skylights are removable and fire rated. Skylights configurations and requirement are not off the shelf and is a special order product. Depending on the manufacturer used the glazing could be dome, flat, single or dual glazing as long as they can meet the requirements.
- Q11. The Skylight schedule is calling out for a 20 minute fire rating for the skylight. The listed manufacture on the plans can provide a Fire Rated Class A, B, or C Roof Assembly per ASTM E-108/UL-790. A 20 minute rating does not apply to this type of product. Confirm the fire rating that is required.
- A11. Fire rating is required since the project is located in a Fire Hazard Severity Zone per the City of San Diego. Class A roof is acceptable in this zone.
- Q12. Please provide standard drawing M-420 referenced on sheet C-8. "8-in Reservoir Vent Pipe, City of San Diego Std. Detail M-420, In 4 Corners, Typ."
- A12. See attached Detail M-420 from the City of San Diego Water Department CIP Guidelines and Standard. Refer to page 10 of this Addendum.

- Q13. Sheet C-8 calls out 6" perforated subdrain collector pipe, see sheet C-3. Sheet C-3 and detail 1/C-4 shows this same pipe as 4" perforated. Please advise.
- A13. The subdrain pipe is 6-inches as shown in C-8 and should be 6-inches in C-3. The Section A/C-4 depicts the 4-inch underdrain connecting to the two 6-inch perforated pipes as shown in C-8. The detail A/C-4, shows a 4-inch subdrain along the exterior-side of the reservoir wall. Refer to page 11 of this Addendum.
- Q14. Please submit the following to Engineer. If this has already been asked please advise when the addendum will be issued:
- TDH for 850 gpm vertical turbine pump
TDH for 500 gpm submersible pump
- A14. See response to A4.
- Q15. With regards to the reservoir shoring. Can we leave the shoring in place and cut only the top 3 ft. section? There will not be enough access to pull shoring on the west and north side after tank is constructed.
- A15. Leaving the shoring in will be acceptable
- Q16. I was hoping to get this approved as an "equal" for the Mixer spec called out in Section 11220. Can you let me know how to properly go about this process and who signs off on this approval?
- A16. Refer to City Whitebook under Trade Names or Equals, Section 4-1.6

James Nagelvoort, Director
Public Works Department

Dated: *April 6, 2017*
San Diego, California

JN/JB/Lad

VERTICAL TURBINE PUMP DATA SHEET, 11214-01

Tag Numbers: P-01

Pump Name: Pump No. 1

SERVICE CONDITIONS:

Liquid Pumped: Potable Water

Pumping Temperature (Fahrenheit): Normal 65 Max 85 Min 40

Specific Gravity at 60 Degrees F: 1 Viscosity Range: 1.05 cst

pH: _____

Abrasive (Y/N): N Caused by: _____

Possible Scale Buildup (Y/N): N Caused by: _____

Corrosive (Y/N): N Caused by: _____

Min. NPSH Available (Ft. Absolute): 33

Suction Pressure (Ft): Max 10 At Rated Capacity 425 gpm

Altitude (Feet above Mean Sea Level): 720

Area Classification: unclassified

Ambient Temperature (degrees F.): 33 to 95

Location: Indoor (Y/N): Y Outdoor (Y/N): N

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 425 Secondary: 200

Total Dynamic Head (Ft): Rated: 218 Secondary: 218

BHP at Rated Point: 29 Secondary: 23

Min. Pump Hydraulic Efficiency at Rated Capacity (%): 80

Max. NPSH Required at Rated Capacity (Ft. Absolute): _____

Max. Pump Speed at Rated Capacity (rpm): 1720

Constant (Y/N): N

Adjustable (Y/N): Y

Discharge Nozzle Size (inches): 6 Flange Standard/Class: 150

DRIVE MOTOR (See Section 16040, Electric Motors.)

Horsepower: 40 Voltage: 460 Phase: 3

Synchronous Speed (rpm): 1800

Service Factor: 1.0

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TEWAC _____ WPI _____ WPII _____

Mounting Type: Vertical Hollow Shaft _____ Nonreverse Ratchet (Y/N) _____
Vertical Solid Shaft X

ABMA 9 and ABMA 11, B-10 Motor Bearing Life (hrs): _____

Adjustable Speed Drive Range: 800 min to 1750 max.
See Section 11033, Variable Frequency Drive.

REMARKS: Provide 1/2-inch pressure tap from discharge head base to suction can for field
installation of a vent valve and pressure gauge. See Drawing detail.
Provide Inverter Duty Motor. Provide motor with oversized motor lead termination box.
Provide motor with embedded thermistors and thermistor monitoring relay mounted on
Motor. Provide motor space heater.

VERTICAL TURBINE PUMP DATA SHEET, 11214-02

Tag Numbers: P-02 and P-03

Pump Name: Pump No. 2 and Pump No. 3

SERVICE CONDITIONS:

Liquid Pumped: Potable Water

Pumping Temperature (Fahrenheit): Normal 65 Max 85 Min 40

Specific Gravity at 60 Degrees F: 1 Viscosity Range: 1.05 cst

pH: _____

Abrasive (Y/N): N Caused by: _____

Possible Scale Buildup (Y/N): N Caused by: _____

Corrosive (Y/N): N Caused by: _____

Min. NPSH Available (Ft. Absolute): 33

Suction Pressure (Ft): Max 10 At Rated Capacity 850 gpm

Altitude (Feet above Mean Sea Level): 720

Area Classification: unclassified

Ambient Temperature (degrees F.): 33 to 95

Location: Indoor (Y/N): Y Outdoor (Y/N): N

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 850 Secondary: 400

Total Dynamic Head (Ft): Rated: 218 Secondary: 270

BHP at Rated Point: 57 Secondary: 42

Min. Pump Hydraulic Efficiency at Rated Capacity (%): 82

Max. NPSH Required at Rated Capacity (Ft. Absolute): _____

Max. Pump Speed at Rated Capacity (rpm): 1720

Constant (Y/N): Y

Adjustable (Y/N): N

Discharge Nozzle Size (inches): 8 Flange Standard/Class: 150

DRIVE MOTOR (See Section 16040, Electric Motors.)

Horsepower: 75 Voltage: 460 Phase: 3

Synchronous Speed (rpm): 1800

Service Factor: 1.0 (for inverter duty motor) 1.15 (for constant speed motor)

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TEWAC _____ WPI _____ WP2 _____

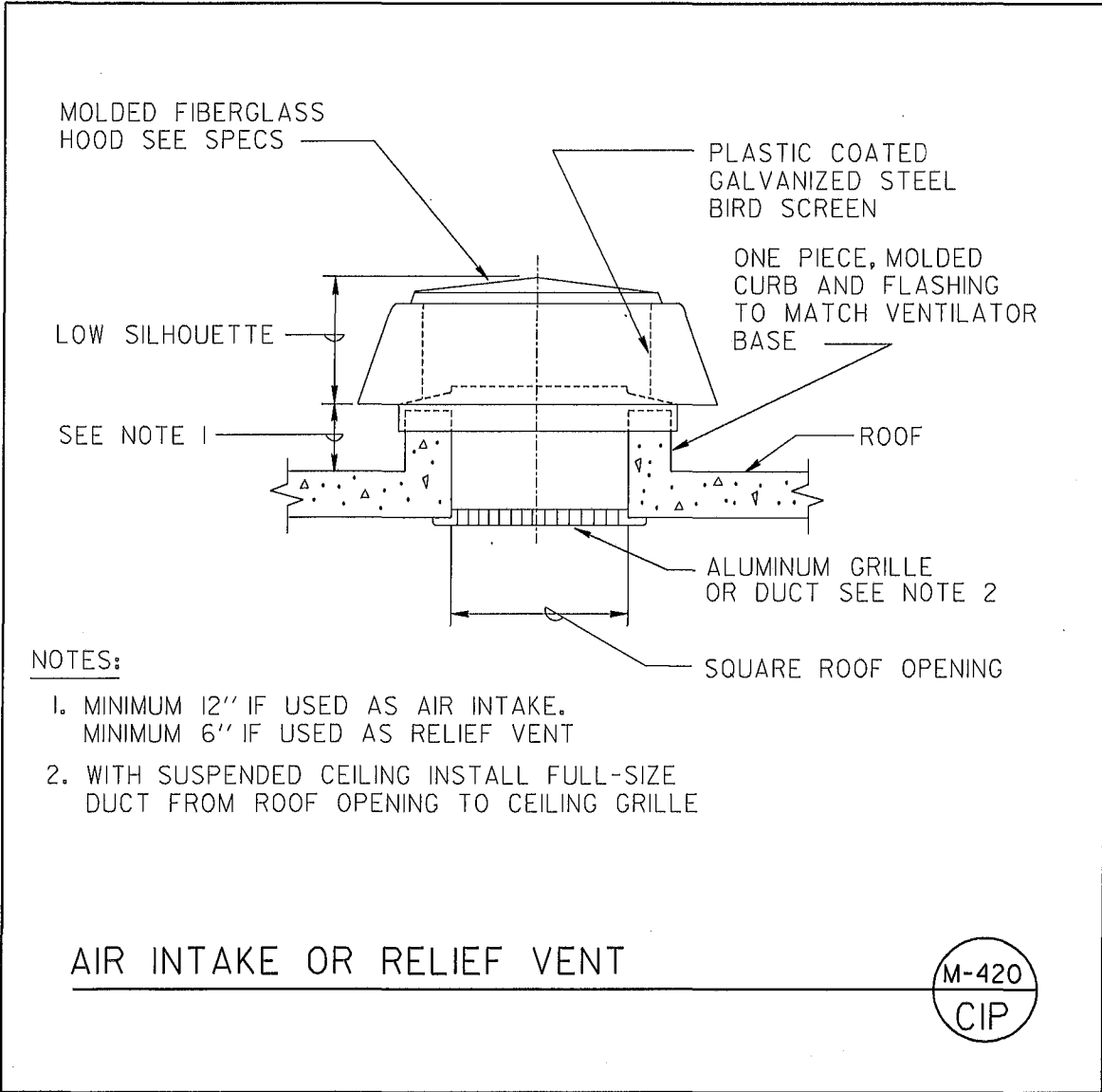
Mounting Type: Vertical Hollow Shaft _____ Nonreverse Ratchet (Y/N) _____
Vertical Solid Shaft X

ABMA 9 and ABMA 11, B-10 Motor Bearing Life (hrs): _____

REMARKS: Provide 1-inch pressure tap from discharge head base to suction can for field installation of a vent valve and pressure gauge. See Drawing detail.

Provide motor with oversized motor lead termination box.

Provide motor with embedded thermistors and thermistor monitoring relay mounted on motor. Provide motor space heater.



NOTES:

1. MINIMUM 12" IF USED AS AIR INTAKE.
MINIMUM 6" IF USED AS RELIEF VENT
2. WITH SUSPENDED CEILING INSTALL FULL-SIZE DUCT FROM ROOF OPENING TO CEILING GRILLE

AIR INTAKE OR RELIEF VENT



REVISION	BY	APPROVED	DATE
REVIEWED BY	INITIALS	DATE	

WATER DEPARTMENT
City of San Diego

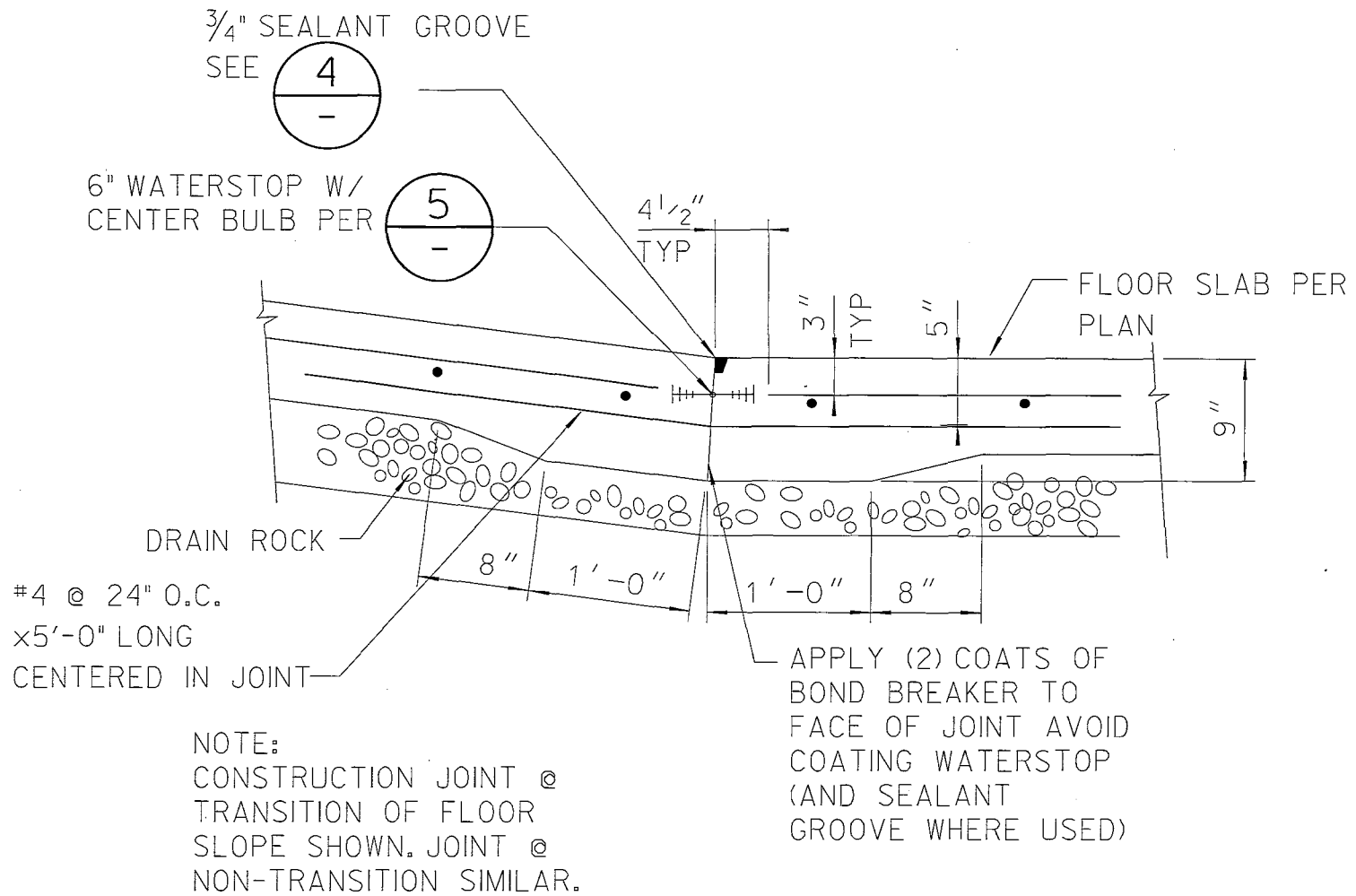


STANDARD
DETAIL

CIP

AIR INTAKE OR RELIEF VENT
ADDENDUM "A"

M-420



FLOOR SLAB CONSTRUCTION JOINT

(6)
VAR

NTS

ADDENDUM "A"

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 PQUAL,CADIR,Local
License # 847555
CADIR 1000002089

Bid Detail

Bid Format Electronic
Submitted May 17, 2017 1:40:51 PM (Pacific)
Delivery Method
Bid Responsive
Bid Status Submitted
Confirmation # 103910
Ranking 0

Respondee Comment

Buyer Comment

Attachments

File Title	File Name	File Type
Bid Bond	Bid Bond.pdf	BID BOND
Certification	Cert Pending Actions.pdf	CONTRACTOR'S CERTIFICATE OF PENDING ACTIONS

Line Items

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment	Reference
Main Bid							
1	Mobilization/Demobilization						
	237110	LS	1	\$235,000.00	\$235,000.00		01025-3.3A
2	Final Operation & Maintenance(O&M) Manuals						
	541330	LS	1	\$1,500.00	\$1,500.00		01025-3.3T
3	Demolition-Pump Station and Reservoir						
	238910	LS	1	\$280,000.00	\$280,000.00		01025-3.3C
4	Sheeting and Shoring						
	237110	LS	1	\$216,000.00	\$216,000.00		01025-3.3D

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment	Reference
5	Structural Excavation and Hauling						
	237110	CY	2720	\$76.50	\$208,080.00		01025-3.3E
6	Pump Station						
	237110	LS	1	\$900,000.00	\$900,000.00		01025-3.3F
7	Reservoir						
	237110	LS	1	\$1,972,000.00	\$1,972,000.00		01025-3.3G
8	Structural Backfill						
	237110	CY	1000	\$96.50	\$96,500.00		01025-3.3H
9	Site Improvements						
	237110	LS	1	\$932,000.00	\$932,000.00		01025-3.3I
10	Surveillance Security Systems - (EOC Type I)						
	238210	AL	1	\$75,000.00	\$75,000.00		01025-3.3J
11	Electrical and Instrumentation						
	238210	LS	1	\$456,700.00	\$456,700.00		01025-3.3K
12	Diesel Generator						
	238910	LS	1	\$75,780.00	\$75,780.00		01025-3.3L
13	SCADA Equipment - (EOC Type I)						
	237110	AL	1	\$25,000.00	\$25,000.00		01025-3.3M
14	Overexcavation/Recompaction - (EOC Type I)						
	237110	AL	1	\$10,000.00	\$10,000.00		01025-3.3N
15	Archeological and Native American Monitoring Program (EOC Type I)						
	541690	AL	1	\$15,000.00	\$15,000.00		01025-3.3O
16	Paleontological Mitigation and Excavation (EOC Type I)						
	541690	AL	1	\$15,000.00	\$15,000.00		01025-3.3P
17	Permanent Storm Water Best Management Practices						
	237110	LS	1	\$136,000.00	\$136,000.00		01025-3.3Q
18	Field Orders - (EOC Type II)						
		AL	1	\$400,000.00	\$400,000.00		9-3.5
19	Special Inspection - (EOC Type I)						
	541380	AL	1	\$40,000.00	\$40,000.00		01025-3.3R
20	Permits - (EOC Type I)						
	541380	AL	1	\$45,000.00	\$45,000.00		7-5.3

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment	Reference
21	Soils Investigation - (EOC Type I)						
	541380	AL	1	\$50,000.00	\$50,000.00		9-3.1
22	Bonds (Payment and Performance)						
	524126	LS	1	\$42,000.00	\$42,000.00		2-4.1
23	Video Recording of Pre-existing Conditions						
	238990	LS	1	\$4,000.00	\$4,000.00		7-9.1.1
24	WPCP Development						
	541330	LS	1	\$1,750.00	\$1,750.00		01025 3.3B
25	WPCP Implementation						
	237990	LS	1	\$19,000.00	\$19,000.00		01025 3.3B
26	Rock Excavation						
	237310	CY	10	\$315.00	\$3,150.00		01025-3.3S
27	Exclusive Community Liaison						
	541820	LS	1	\$18,000.00	\$18,000.00		7-16.4
28	SDGE Transformer & Switchboard Relocation						
	238210	LS	1	\$14,000.00	\$14,000.00		01025-3.3U
					Subtotal	\$6,286,460.00	
					Total	\$6,286,460.00	

Subcontractors

Name & Address	Description	License Num	CADIR	Amount	Type
Jennette Company, Inc. 11512 Trailbrook Lane San Diego, CA 92128 United States	Demolition/Building Work/Waterproof/Fence/Pavi ng/Reinforcement/Landscape	1007413	1000042413	\$1,350,000.00	ELBE
McMahon Engineering Construction 634 Rock Springs Rd. Escondido, CA., CA 92025 United States	Shoring	1009853	1000034207	\$180,000.00	
Concrete Building Systems 3485 Live Oak Creek Circle,Fallbrook, CA, 92028 Fallbrook, CA 92028 United States	Concrete	484842	1000000942	\$1,165,752.00	CADIR,CAU,ELBE,F EM,WBE