NOTICE TO CONTRACTORS, PROPOSAL, AGREEMENT, & SPECIAL PROVISIONS

FOR CONSTRUCTION ON
Project No: 18-59
Well 8 GAC System Rehabilitation and Site Work

IN STANISLAUS COUNTY,
TURLOCK, CALIFORNIA.

Development Services Department/Engineering Division

Phone: (209) 668-5599 x 4417
Contact Person: Stephen Fremming, PE

Nathan Bray, PE
Development Services Director/City Engineer

Proposals shall be delivered to Turlock, California
at or before 2:00 PM on December 6, 2018
at the office of the City Engineer,
Development Services: Engineering Division
156 S. Broadway, Suite 150
Turlock, CA 95380

Bid Set
November 5, 2018

REGISTERED PROFESSIONAL ENGINEER
NATHAN B. BRAY
C 76642
CIVIL
STATE OF CALIFORNIA
11/7/18

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CITY OF TURLOCK, CALIFORNIA
NOTICE TO CONTRACTORS

Sealed proposals will be received by the City Engineer of the City of Turlock, Development Services/Engineering Division, 156 S. Broadway, Suite 150, Turlock, California 95380, until 2:00 PM on December 6, 2018, for:

City Project No. 18-59
Well 8 GAC System Rehabilitation and Site Work

In accordance with and as described and provided in the plans, specifications and the proposed form of contract therefore, all of which are on file in the office of the City Engineer, and to which special reference is hereby made.

No verbal, telegraphic, electronic mail, facsimile, or telephone Proposals shall be considered.

Proposals are required to be complete and for the entire work, materials and improvements unless the contrary is indicated in the specifications.

In accordance with the provisions of California Business and professions Code, Section 7028, Contractor shall possess one of the following Contractor license(s) at the time of bid and for the duration of the contract:

A-General Engineering Contractor

Failure to possess the specified license(s) shall render the Bid as non-responsive, shall act as a bar to award of the contract to any Bidder not possessing said license(s) at the time of Bid opening and shall result in the forfeiture of the security of said Bidder. Furthermore, any Bidder or Contractor not so licensed shall be subject to all legal penalties imposed by law, including, but not limited to, any appropriate disciplinary action by the Contractor's License Board.

Each proposal must be accompanied by cash, cashier's check, or check certified by a responsible bank, or by a bid bond, the proposed form of which is on file in the office of the City Engineer of said City and to which special reference is hereby made in a sum not less than ten percent (10%) of the total amount bid, payable to the City of Turlock as liquidated damages in the case the bidder is awarded the contract and fails within ten (10) days after the date of mailing to him by the City Engineer of a notice of award of the contract and that the contract is ready for signature to execute the above-mentioned written contract and file with the City Engineer satisfactory insurance certificates as required by the terms of said contract and satisfactory bonds as required by law for the faithful performance of said contract and for the protection of material, men and laborers. Special reference is hereby made to Sections 5100, et. seq., of the Public Contracts Code of the State of California and to the proposed forms for said bonds now on file in the office of the said City Engineer for further particulars regarding bonds.

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county Stanislaus in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at 156 S. Broadway St, Turlock, CA 95380 and available from the California Department of Industrial Relations' Internet web site at http://www.dir.ca.gov/DLSR/PWD.

Bidders' attention is directed to the insurance requirements in the contract. It is highly recommended that bidders confer with their respective insurance carriers or brokers to determine in advance of bid submission the availability of insurance certificates and endorsements prescribed and provided herein. If an apparent low bidder fails to comply strictly with the insurance requirements, that bidder may be disqualified from award of the contract.

No proposal will be considered unless made on forms furnished by the City Engineer of said City at his office of said City. Each proposal must be sealed, and the envelope containing the same must be addressed to the City Engineer of the City of Turlock and must be plainly marked. Each proposal shall clearly identify the bidders name and address on the sealed envelope.

Each bid shall separately state in figures the price offered for the approximate quantity of each item set forth and shall also state in words and figures the total contract price. Quantities set forth in the proposal form and in the specifications are approximate only, being given as a basis for comparison of bids, and the City of Turlock does not expressly or implied agree that the actual amount of work or materials will correspond therewith, but reserves the right to increase or decrease the amount of any class or portion of the work or materials as may be deemed necessary by the City Engineer.

Proposals may not be withdrawn for a period of sixty (60) days after the time fixed for opening of proposals. The City Council of the City of Turlock reserves the right to reject any and all proposals or any part thereof and to waive any errors or informalities in any proposals and to set and act as sole judge of the merit and qualifications of the equipment, supplies or services offered.

At the request and expense of Contractor, pursuant to Division 2, Part 5, Section 22300, et. seq., of the Public Contracts Code, securities equivalent to any funds withheld as retention from progress payments made under this contract may be deposited with the City of Turlock or with a State or Federally chartered bank as escrow agent, who shall pay such moneys to Contractor upon completion of the contract.

Copies of the Contract Documents, including Instructions to Bidders, Bid Proposal forms, Plans and Specifications, may be downloaded from the engineering division's web site or purchased for a non-refundable fee of **Four Hundred Fifty** dollars **($450.00)** at the Office of the City Engineer, 156 S. Broadway, Ste. 150, Turlock, CA 95380, Phone (209) 668-5520. For additional information, go to **http://www.CityofTurlock.org/capitalprojects**

The U.S. Department of Transportation (DOT) provides a toll-free "hotline" service to report bid rigging activities. Bid rigging activities can be reported Mondays through Fridays, between 8:00 a.m. and 5:00 p.m., Eastern Time, Telephone No. 1-800-424-9071. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report these activities. The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

No contractor or subcontractor may be listed on a bid proposal for a public works unless registered with the Department of Industrial Relations pursuant to Labor Code Section 1725.5. No contractor or subcontractor may be awarded a contract for public work on a public works unless registered with the Department of Industrial Relations pursuant to Labor Code Section 1725.5.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations. The contractors and subcontractors must furnish electronic certified payroll records to the Labor Commissioner.

The contractor shall post job site notices prescribed by regulation. (See 8 Calif. Code Reg. §16451(d) for the notice that previously was required for projects monitored by the CMU.)

DATED: 11/7/18

CITY OF TURLOCK

by: _____

Nathan Bray, PE
Development Services Director/
City Engineer

PROPOSAL

City Project No. 18-59
Well 8 GAC System Rehabilitation and Site Work

City of Turlock, California

DATED:_____

to: The Honorable City Council of the City of Turlock, California:

NAME OF BIDDER:_____

BUSINESS ADDRESS:_____

PLACE OF RESIDENCE:_____

Bids are to be submitted for the entire work. The amount of the bid for comparison purposes will be the total of all items. The bidder shall set forth for each unit basis item of work a unit price and a total for the item, and for each lump sum item a total for the item, all in clearly legible figures in the respective spaces provided for that purpose.

In the case of unit basis items, the amount set forth under the "Item total" column shall be the product of the unit price bid and the estimated quantity for the item. in case of discrepancy between the unit price and the total set forth for a unit basis item, the unit price shall prevail except as provided in (a) or (b), as follows:

(a) If the amount set forth as unit price is unreadable or otherwise unclear, or is omitted, or is the same as the amount as the entry in the item total column, then the amount set forth in the item total column for the item shall prevail and shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price;

(b) (Decimal Errors) If the product of the entered unit price and the estimated quantity is exactly off by a factor of ten, one hundred, etc., or one-tenth, or one-hundredth, etc. from the entered total, the discrepancy will be resolved by using the entered unit price or item total, whichever most closely approximates percentage wise the unit price or item total in the Department's Final Estimate of cost.

The Contractor shall submit the following at the time of Bid in order for the Bid to be considered responsive:

- Completed Proposal, pages 3-12

In accordance with the annexed Notice to Contractors, the undersigned, as bidder, declares that he has carefully examined the location of the proposed work, the plans, specifications and technical requirements therefore, and the proposed forms of contract and bonds mentioned or referred to in said Notice and on file in the office of the City Engineer of the City of Turlock, together with the prevailing rate of per diem wages for each craft or type of workmen needed to execute said contract; and he proposes and agrees that if this proposal is accepted, he will furnish all labor, materials, equipment, plant transportation, service, sales taxes, permit fees and other costs necessary to complete the construction in strict conformity to the plans and specifications and he will enter into a written contract with the City of Turlock in the form of contract on file in the Office of the City Engineer for such purposes, and that he will execute and/or provide all bonds and insurance certificates required by law and/or by said contract and/or mentioned in said Notice to Contractors all in accordance with and subject to all applicable laws, and that he will take in full payment therefore the following unit prices, to wit:

BIDDING FORM

Bid Item No.	Qty.	Description	Unit Price ($)	Total Amount ($)
1.	LS	Clean and Test GAC Vessels	-	
2.	LS	GAC Manifold Piping	-	
3.	LS	GAC Vessel and Piping Recoating/Piping Relining	-	
4.	50 SF	GAC Vessel Lining Repair		
5.	LS	Chlorine Injection and Chemical Building	-	
6.	LS	Reroof Pump Building	-	
7.	LS	New Pump and Motor with Variable-Frequency Drive	-	
8.	LS	Chlorine and Nitrate Monitoring Equipment	-	
9.	LS	Electrical Work and Instrumentation	-	
10.	LS	Painting of Pump House	-	
11.	LS	Mobilization/Demobilization	-	
		Total Bid Amount		

TOTAL BID WRITTEN IN WORDS: _____

Bidder has examined and carefully studied the Bidding documents and other related data identified in the Bidding Documents and the following Addenda, receipt of which is hereby acknowledged

ADDENDA

No._____	**Date** _____	**Signed** _____
No._____	**Date** _____	**Signed** _____
No._____	**Date** _____	**Signed** _____
No._____	**Date** _____	**Signed** _____
No._____	**Date** _____	**Signed** _____

BIDDER'S NAME: _____

COMPANY'S NAME: _____

BY: _____

ADDRESS: _____
(Number) (Street)

_____
(City) (State) (ZIP)

CONTRACTOR'S PHONE #:_____

NOTE: CONTRACTOR WILL BE REQUIRED TO LIST THEIR LICENSE NUMBER, EXPIRATION DATE, AND APPROPRIATE STATEMENT REGARDING PERJURY AND SIGNED BY INDIVIDUAL AUTHORIZED TO DO SO. FAILURE TO INCLUDE THE ABOVE ITEMS MAY CAUSE SAID CONTRACTOR'S BID TO BE REJECTED.

_____, Contractor's License #_____, Class__
(Company's Name)

Expires_____. DIR #:_____

This information is true, is provided as per Section 7028.15 of the Business and Professions Code, and is made herein under penalty of perjury.

_____
(Bidder's Signature) (Date)

If the proposal is accepted and the undersigned shall fail to contract as aforesaid and fail to file with the City insurance certificates as required by said contract, within fourteen (14) days after the bidder has received notice from the City Engineer or his representative of the City of Turlock that the contract has been awarded to bidder and is ready for signature, the City of Turlock may, at its option, determine that the bidder has abandoned his contract, and thereupon this proposal and the acceptance thereof shall be null and void.

Also accompanying this proposal is an affidavit of noncollusion and questionnaire to general contractors, a statement of proposed subcontractors, if any, the address of mill, shop or office of any subcontractor, and a statement of work to be performed by subcontractors.

The names and addresses of persons interested in the foregoing proposal as principals are as follows:

(**IMPORTANT NOTICE**: If bidder or other interested person is a corporation, state legal name of corporation, also names of the president, secretary, treasurer, and manager thereof; if a partnership, state true name of firm, also names of all individual copartners composing firm; if bidder or other interested person is an individual, state first and last name in full.)

Licensed in accordance with an act providing for the registration of Contractors,
License No._____Expiration Date_____.

DATED:_____, 20_____

Address:_____

Phone:_____

_____
Signature of Bidder

NOTE: If bidder is a corporation, the legal name of the corporation shall be set forth above together with the signature of the officers authorized to sign contracts on behalf of the corporation; if bidder is a co partnership, the true name of the firm shall be set forth above together with the signature of the partner or partners authorized to sign contracts in behalf of the co partnership; and, if bidder is an individual, his signature shall be placed above. If a signature is by an agent other than an officer of a corporation or a member of the partnership, a Power of Attorney must be on file with the City Clerk prior to opening or submitted with the bid; otherwise, the bid will be disregarded as irregular and unauthorized.

AFFIDAVIT

The undersigned bidder, being first duly sworn, deposes and says that he/she are the party making the foregoing proposal or bid, that this bid is genuine and not collusive or sham, that said bidder has not colluded, conspired, connived or agreed, directly or indirectly, with any other person or bidder, to put in a sham bid, or that said other person shall refrain from bidding, and has not in any manner sought by collusion to secure any advantage against the said City or any person interested in said improvement, for him/herself or any other person.

_____

Signature of Bidder

Jurat (Government Code Section 8202)

State of California

County of _____

Subscribed and sworn to (or affirmed) before me on this _____ day of _____, 20_____

by _____ proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

(AFFIX SEAL)

_____

NOTARY PUBLIC SIGNATURE

_____

NOTARY PUBLIC PRINTED NAME

INFORMATION REQUIRED OF BIDDER

The bidder is required to provide the following information. Additional sheets may be attached if necessary.

Contractor's mailing address:_____

Contractor's telephone number:_____

Number of years' experience as a contractor in construction work or installation work similar to that required in these specifications:

_____

Name of person who inspected the site of the proposed work for your firm:

_____

Date of Inspection:_____

List at least four projects of comparable size and scope completed as of recent date:

Project No. and Title: _____
Class and Type of Work: _____
Name, Address, and Phone No. of Owner _____
Registered Engineer in Charge of Project: _____
Total Contract Amount: _____
Contract Amount You Performed: _____
Name of Prime Contractor if you were Sub: _____
Date Completed: _____
Liquidated Damages Assessed: _____

Project No. and Title: _____
Class and Type of Work: _____
Name, Address, and Phone No. of Owner _____
Registered Engineer in Charge of Project: _____
Total Contract Amount: _____
Contract Amount You Performed: _____
Name of Prime Contractor if you were Sub: _____
Date Completed: _____
Liquidated Damages Assessed: _____

Project No. and Title: _____
Class and Type of Work: _____
Name, Address, and Phone No. of Owner _____
Registered Engineer in Charge of Project: _____
Total Contract Amount: _____
Contract Amount You Performed: _____
Name of Prime Contractor if you were Sub : _____
Date Completed: _____
Liquidated Damages Assessed: _____

Project No. and Title: _____
Class and Type of Work: _____
Name, Address, and Phone No. of Owner _____
Registered Engineer in Charge of Project: _____
Total Contract Amount: _____
Contract Amount You Performed: _____
Name of Prime Contractor if you were Sub : _____
Date Completed: _____
Liquidated Damages Assessed: _____

BIDDER'S BOND

KNOW ALL MEN BY THESE PRESENTS:
That we _____ as
BIDDER, and _____ as
SURETY a corporation duly organized under the laws of the State of _____
and duly licensed to become sole Surety on bonds required and authorized by the State of California, as SURETY, are held and firmly bound unto the City of Turlock, hereinafter called the City, in the penal sum of TEN PERCENT (10%) OF THE TOTAL AMOUNT OF THE BID of the Bidder above named, submitted by said Bidder to the City, for the work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents. in no case shall the liability of the Surety hereunder exceed the sum _____

_____
Dollars ($_____).

THE CONDITION OF THIS OBLIGATION IS SUCH THAT, whereas the bidder has submitted the above-mentioned bid to the City for certain construction specifically described as follows for which bids are to be opened at Engineering Division, Development Services Department, City Hall, 156 S. Broadway Suite 150, Turlock, California, on

_____, _____, 20____, at_____.
(day) (date) (time)

for **Project No. 18-59 "Well 8 GAC System Rehabilitation and Site Work"**

NOW, THEREFORE, if the aforesaid Bidder is awarded the contract and, within the time manner required under the specifications after the prescribed forms are presented to him for signature, enters into a written contract in the prescribed form in accordance with the bid, and files the two bonds with the City, one to guarantee faithful performance and the other to guarantee payment for labor and materials as required by law, then obligation shall be null and void; otherwise, it shall be and remain in full force and virtue.

In the event suit is brought upon this bond by the Obligee and judgment is recovered, the Surety shall pay all costs incurred by the Obligee in such a suit, including a reasonable attorney's fee to be fixed by the court.

IN WITNESS WHEREOF, we have hereunto set our hands and seals on this _____day of _____, 201_.

BIDDER

_____**(SEAL)**
(Bidder's Name and Corporate Seal)

_____
(Signature)

_____
(Print Name and Title)

(ATTACH ACKNOWLEDGMENT OF BIDDER)

SURETY

_____**(SEAL)**
(Surety's Name and Corporate Seal)

_____
(Signature)

_____
(Print Name and Title)

(ATTACH ACKNOWLEDGMENT OF SURETY'S ATTORNEY-IN-FACT)

NOTE: ATTACH CERTIFIED COPY OF POWER OF ATTORNEY

SUBCONTRACTORS

City Project No. 18-59

Well 8 GAC System Rehabilitation and Site Work

Prime Contractor:_____ DIR NUMBER:_____

Pursuant to California Public Contract Code §4100, the Bidder shall list each subcontractor who will perform Work or labor or who will render service to the prime Contractor in or about the construction of the Work or improvement, or a subcontractor duly licensed who, under subcontract to the prime Contractor, specially fabricates and installs a portion of the Work or improvement according to detailed Drawings contained in the Contract Documents, in an amount in excess of 1/2 of 1 percent of the prime Contractor's total Bid or, in the case of Bids or offers for the construction of streets or highways, including bridges, in excess of 1/2 of 1 percent of the prime Contractor's total Bid or $10,000, whichever is greater. After the opening of Bids, no changes or substitutions will be allowed except as otherwise provided by law. The listing of more than one subcontractor for each item of Work to be performed with the words "and/or" will not be permitted.

IF NO SUBCONTRACTORS WILL FURNISH WORK, THEN WRITE "NONE" BELOW IN THE SPACE PROVIDED.

NAME	LICENSE NUMBER	DIR NUMBER	ADDRESS	WORK ITEMS TO BE PERFORMED AND % OF ITEM

AGREEMENT

FOR PUBLIC IMPROVEMENT

City Project No. 18-59

Well 8 GAC System Rehabilitation and Site Work

THIS AGREEMENT is entered into by and between the CITY OF TURLOCK, a Municipal Corporation, hereinafter called "City," and _____ hereinafter called "Contractor" on this ____ day of _____, 20__ (hereinafter called the "Agreement").

RECITALS

A City has taken appropriate proceedings to authorize construction of the public work and improvements herein provided and execution of this contract.

B A notice was duly published for bids for the contract for the improvement hereinafter described pursuant to Public Contract Code § 20164.

C On _____, 20__, after notice duly given, the City Council of the City of Turlock awarded the contract for the construction of the improvements hereinafter described to Contractor, which Contractor said Council found to be the lowest responsible bidder for said improvements.

D City and Contractor desire to enter into this Agreement for the construction of said improvements.

IT IS AGREED AS FOLLOWS:

1. Scope of Work:

Contractor shall perform the work described briefly as follows:

The work consists, in general, of rehabilitation of the existing GAC system at the Well 8 site, installation of a new well pump and VFD, installation of a new chlorine injection system, and installation of a nitrate monitoring system with a flush-to-waste option and furnishing all necessary labor, materials, tools, equipment and incidentals needed to perform the improvements as shown on the contract plans complete and in place. This work shall be completed in accordance with the project specifications, drawings and these special provisions.

The improvements are further described in the plans, specifications and technical requirements for such project, copies of which are on file in the office of the City Engineer, and which are incorporated by reference herein.

2. The Contract:

The complete contract consists of the following documents: This agreement, the notice to contractors, the contractor's accepted proposal, general conditions, special provisions, plans and detailed drawings, addendums, faithful performance bond, labor and materials bond, and any and all supplemental agreements amending, decreasing, or extending the work contemplated or which may be required to complete the work in a substantial and acceptable manner. The current edition of the "City of Turlock Standard Specifications and Drawings" is hereby incorporated as a part of the contract.

All rights and obligations of City and Contractor are set forth and described in the contract.

All of the above named documents are intended to incorporate the terms of the others so that any work called for in one and not mentioned in the other, or vice versa, is to be executed the same as if mentioned in all said documents. The documents comprising the complete contract will hereinafter be referred to as the "Contract". In case of any dispute regarding the terms of the Contract, the decision of the City Engineer shall be final.

3. Schedule:

All work shall be performed in accordance with the schedule approved by the City Engineer, or designated agent, and under his/her direction.

4. Equipment & Performance of Work:

Contractor shall furnish all tools, equipment, facilities, labor and materials necessary to perform and complete in good workmanlike manner the work of general construction as called for and in the manner designated in, and in strict conformity with, the plans and specifications for said work entitled, "General Conditions and Special Provisions for **City Project No. 18-59 "Well 8 GAC System Rehabilitation and Site Work"**

The equipment, apparatus, facilities, labor and material shall be furnished, and said work performed and completed as required in said plans and specifications under the direction and supervision, and subject to the approval of the City Engineer of said City, or City Engineer's designated agent.

5. Contract Price:

City shall pay, and Contractor shall accept in full payment for the work above agreed to be done, an amount not to exceed _____ **and XX/100ths Dollars ($_____.__).** Said amount shall be paid in installments as hereinafter provided.

6. Time for Performance:

The time fixed for the commencement of such work is within ten (10) working days after the "Notice to Proceed" has been issued. The work on this project for Bid Items 1 through 11, including all punch list items, shall be completed on or before the expiration of 200 Consecutive Calendar Days beginning on the first day of work or no later than the tenth day after the "Notice to Proceed" has been issued.

7. Rights of City to Increase Working Days:

If such work is not completed within such time, the City Engineer shall have the right to increase the number of working days in the amount the City Engineer may determine will best serve the interests of the City, and if the City Engineer desires to increase said number of working days, the City Engineer shall have the further right to charge the Contractor and deduct from the final payment for the work the actual cost of engineering, inspection, superintendence, and other overhead expenses which are directly chargeable to Contractor, and which accrue during the period of such extension, except that the cost of the final service and preparation of the final estimates shall not be included in such charges; provided, however, that no extension of time for completion of such work shall ever be allowed unless requested by Contractor at least twenty (20) calendar days prior to the time herein fixed for the completion thereof, in writing, to the City Engineer. It is understood that the City Engineer shall not consider any such requests if not filed within the time set forth above in this section.

8. Option of City to Terminate Agreement in Event of Failure to Complete Work:

If Contractor shall have refused or failed to prosecute the work, or any severable part thereof, with such diligence as will ensure its completion within the time specified or any extensions thereof, or shall have failed to complete said work within such time if Contractor should be adjudged a bankrupt, or if Contractor should make a general assignment for the benefit of Contractor's creditors, or if a receiver should be appointed in the event of Contractor's insolvency, or if Contractor or any subcontractor should violate any of the provisions of this Contract, the City Engineer or the City Council may give written notice to Contractor and Contractor's sureties of its intention to terminate this agreement, and unless within five (5) days after the serving of such notice such violation shall

cease and satisfactory arrangements for the correction thereof made, this agreement may, at the option of City, upon the expiration of said time, cease and terminate.

9. Delay Damages:

In the event the Contractor, for any reason, shall have failed to perform the work herein specified to the satisfaction of the City Engineer within the time herein required, the City may, in accordance with Section 7203 of the Public Contract Code, in lieu of any other of its rights authorized by paragraph 8 of this agreement, deduct from payments or credits due Contractor after such breach, a sum equal to Five Hundred and no/100ths Dollars **($500.00)** for each calendar day beyond the date herein provided for the completion of such work. This deduction shall not be considered a penalty but shall be considered as delay damages. The aforementioned rate of deduction is an amount agreed to by the Contractor and the City as reasonably representing additional construction engineering costs incurred by the City if the Contractor fails to complete the work within the contract time. However, any deduction assessed as delay damages shall not relieve the Contractor from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed Contractor to complete the work within the contract time. Due account shall be taken of any time extensions granted to the Contractor by the City. Permitting the Contractor to continue work beyond the contract completion date shall not operate as a waiver on the part of the City of any of its rights under the contract nor shall it relieve the Contractor from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed Contractor to complete the work within the contract time.

10. Performance By Sureties:

In the event of any termination as hereinbefore provided, City shall provide timely written notice thereof to Contractor and Contractor's sureties, and the sureties shall have the right to take over and perform the Contract; provided, however, that if the sureties within five (5) days after giving them said notice of termination, do not give the City written notice of their intention to take over the performance of the Contract and do not commence performance thereof within five (5) days after notice to the City of such election, City may take over the work and prosecute the same to completion by contract or by any other method it may deem advisable for the account, and at the expense of Contractor and the sureties shall be liable to City for any excess cost or damages occasioned City thereby; and, in such event, City may, without liability for so doing, take possession of and utilize in completing the work such materials, appliances, plant and other property belonging to Contractor as may be on the site of the work and necessary therefor.

11. Disputes Pertaining To Payment For Work:

Should any dispute arise respecting the true value of any work done, of any work omitted, or of any extra work which Contractor may be required to do, or respecting the size of any payment to Contractor during the performance of this contract, such dispute shall be decided by the City Engineer, and the decision of the latter shall be final and conclusive. Contractor and City agree to comply with the claims resolution procedures set forth in Public Contract Code § 9204 when applicable.

Any submission of a claim by Contractor must comply with the requirements of Public Contract Code §9204. Upon receipt of a claim pursuant to this section, the City shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the Contractor a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, the City and Contractor may, by mutual agreement, extend the time period provided in this subdivision. The Contractor shall furnish reasonable documentation to support the claim. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the City issues its written statement. If the Contractor disputes the City's written response, or if the City fails to respond to a claim issued pursuant to this section within the time prescribed, the Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the City shall schedule a meet and confer conference within 30 days for settlement of the dispute.

Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the City shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the City issues its written statement. Any disputed portion of the claim, as identified by the Contractor in writing, shall be submitted to nonbinding mediation, with the City and the claimant sharing the associated costs equally. The City and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

Notwithstanding any claim, dispute or other disagreement between the City and the Contractor regarding performance under the Contract Documents, the scope of Work thereunder, or any other matter arising out of or related to, in any manner, the Contract Documents, the Contractor shall proceed diligently with performance of the Work in accordance with the City's written direction, pending any final determination or decision regarding any such claim, dispute or disagreement.

12. Permits, Compliance With Law:

Contractor shall, at Contractor's expense, obtain all necessary permits and licenses for the construction of each improvement, give all necessary notices and pay all fees and taxes required by law, except those City fees set forth in the Special Provisions Section 1.

In accordance with the provisions of Sections 1725.5, 1771.1, 1771.3, and 1771.4 of the Labor Code, this project is subject to compliance monitoring and enforcement by the DIR. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal (subject to the requirements of Section 4104 of the Public Contract Code), or engage in the performance of any contract for public work, as defined by that chapter of the Labor Code, unless currently registered and qualified to perform public work pursuant to Section 1725.5 of the Labor Code. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions Code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.

In accordance with the provisions of Section 1773.3 of the Labor Code, the City of Turlock shall provide notice to the DIR of the award of any public works contract subject to the requirements of Chapter 1 of the Labor Code, within five days of the award. The notice shall be transmitted electronically in a format specified by the DIR (see https://www.dir.ca.gov/pwc100ext/) and shall include the name of the contractor, any subcontractor listed on the successful bid, the bid and contract award dates, the contract amount, the estimated start and completion dates, jobsite location, and any additional information the DIR specifies that aids in the administration and enforcement of this chapter.

Prevailing wage rates are required to be posted at the jobsite by the Contractor.

13. Superintendence By Contractor:

Contractor shall give personal superintendence to the work on said improvement or have a competent foreman or superintendent satisfactory to the City Engineer on the project at all times during construction and performance of work under the Contract, with authority to act for him.

14. Inspection By City:

Contractor shall at all times maintain proper facilities and provide safe access for inspection by City to all parts of the work and to the shops wherein the work is in preparation.

15. Extra And/Or Additional Work And Changes:

The City, at any time, by written order, may make changes within the general scope of the work under the Contract or issue additional instructions, require additional work or direct deletion of work. The Contractor shall not proceed with any change involving an increase or decrease in the Contract price or the Contract time without prior written authorization from the City. The foregoing notwithstanding, the Contractor shall promptly commence and diligently complete any change to the work subject to the City's written authorization issued pursuant to the preceding sentence; the Contractor shall not be relieved or excused from its prompt commencement if necessary, and diligent completion of any change subject to the City's written authorization by virtue of the absence or inability of the Contractor and the City to agree upon the extent of any adjustment to the Contract time or the Contract price on account of such change. The issuance of a Change Order pursuant to this Section in connection with any change authorized by the City under this Section shall not be deemed a condition precedent to Contractor's obligation to promptly commence and diligently complete any such change authorized by the City hereunder. The City's right to make changes shall not invalidate the Contract nor relieve the Contractor of any liability or other obligations under the Contract Documents. Any requirement of notice of Changes in the scope of Work to the Surety shall be the responsibility of the Contractor.

In the event work is performed or materials furnished in addition to those set forth in Contractor's bid and the specifications herein, said work and materials shall be paid for at the unit price therein contained. Said amount shall be paid in installments as hereinafter provided.

16. Change Of Contract Price:

The contract price may only be changed by a contract change order. The value of any work covered by a contract change order for an adjustment in the contract price will be determined in the City's sole discretion as follows:

(a) If the work performed is on the basis of unit prices contained in the contract documents, the change order will be determined in accordance with the provisions in Section 4-1.05, "Changes and Extra Work", of the Caltrans Standard Specifications; or

(b) If the work performed is not included on the engineers estimate associated with a unit price, the change order will be by a mutually agreed lump sum; or

(c) If the change order is not determined as described above in either 16 (a) or 16 (b), the change order will be determined on the basis of force account in accordance with the provisions below.

FORCE ACCOUNT

For work paid by force account, the Engineer compares the City's records to the Contractor's daily force account work report. When the Engineer and the Contractor agree on the contents of the daily force account work reports, the Engineer accepts the report and the City pays for the work. If the records differ, the City pays for the work based only on the information shown on the City's records.

If a subcontractor performs work at force account, accept an additional 2 percent markup to the total cost of that work paid at force account, including markups specified as below, as reimbursement for additional administrative costs.

The markups specified in labor, materials, and equipment includes compensation for all delay costs, overhead costs, and profit.

If an item's unit price is adjusted for work-character changes, the City excludes the Contractors cost of determining the adjustment.

Payment for owner-operated labor and equipment is made at the market-priced invoice submitted.

Labor

Labor payment is full compensation for the cost of labor used in the direct performance of the work plus a 5 percent markup, as set forth below, and consistent with the California Labor Code. Force account labor payment consists of:

1. Employer payment to the worker for:
   1.1. Basic hourly wage
   1.2. Health and welfare
   1.3. Pension
   1.4. Vacation
   1.5. Training
   1.6. Other State and federal recognized fringe benefit payments
2. Labor surcharge percentage in *Labor Surcharge and Equipment Rental Rates* current during the work paid at force account for:
   2.1. Workers' compensation insurance
   2.2. Social security
   2.3. Medicare
   2.4. Federal unemployment insurance
   2.5. State unemployment insurance
   2.6. State training taxes
3. Subsistence and travel allowances paid to the workers
4. Employer payment to supervisors, if authorized

The 5 percent markup consists of payment for all overhead costs related to labor but not designated as costs of labor used in the direct performance of the work including:

1. Home office overhead
2. Field office overhead
3. Bond costs
4. Profit
5. Labor liability insurance
6. Other fixed or administrative costs that are not costs of labor used in the direct performance of the work

Materials

Material payment is full compensation for materials the Contractor furnishes and uses in the work. The Engineer determines the cost based on the material purchase price, including delivery charges, except:

1. A 5 percent markup is added
2. Supplier discounts are subtracted whether the Contractor takes them or not
3. If the Engineer believes the material purchase prices are excessive, the City pays the lowest current wholesale price for a similar material quantity
4. If the Contractor procured the materials from a source the Contractor wholly or partially own, the determined cost is based on the lower of the:
   4.1. Price paid by the purchaser for similar materials from that source on Contract items
   4.2. Current wholesale price for those materials
5. If the Contractor does not submit a material cost record within 30 days of billing, the determined cost is based on the lowest wholesale price:
   5.1. During that period
   5.2. In the quantities used

Equipment Rental

Equipment rental payment is full compensation for:

1. Rental equipment costs, including moving rental equipment to and from the change order work site using its own power.
2. Transport equipment costs for rental equipment that cannot be transported economically using its own power. No payment is made during transport for the transported equipment.
3. 5 percent markup.

If the Contractor wants to return the equipment to a location other than its original location, the payment to move the equipment must not exceed the cost of returning the equipment to its original location. If the Contractor uses the equipment for work other than work paid by force account, the transportation cost is included in the other work.

Before moving or loading the equipment, obtain authorization for the equipment rental's original location.

The Engineer determines rental costs:

1. Using rates in Labor Surcharge and Equipment Rental Rates:
   1.1. By classifying equipment using manufacturer's ratings and manufacturer-approved changes.
   1.2. Current during the work paid by force account.
   1.3. Regardless of equipment ownership; but the City uses the rental document rates or minimum rental cost terms if:
      1.3.1. Rented from equipment business the Contractor does not own.
      1.3.2. The Labor Surcharge and Equipment Rental Rates hourly rate is $10.00 per hour or less.
2. Using rates established by the Engineer for equipment not listed in Labor Surcharge and Equipment Rental Rates. The Contractor may submit cost information that helps the Engineer establish the rental rate; but the City uses the rental document rates or minimum rental cost terms if:
   2.1. Rented from equipment business the Contractor does not own.
   2.2. The Engineer establishes a rate of $10.00 per hour or less.
3. Using rates for transport equipment not exceeding the hourly rates charged by established haulers.

Equipment rental rates include the cost of:

1. Fuel
2. Oil
3. Lubrication
4. Supplies
5. Small tools that are not consumed by use
6. Necessary attachments
7. Repairs and maintenance
8. Depreciation
9. Storage
10. Insurance
11. Incidentals

The City pays for small tools consumed by use. The Engineer determines payment for small tools consumed by use based on Contractor-submitted invoices.

The Engineer may authorize rates in excess of those in the *Labor Surcharge and Equipment Rental Rates* if:

1. The Contractor submits a request to use rented equipment
2. Equipment is not available from the Contractors normal sources or from one of the Contractors subcontractors
3. Rented equipment is from an independent rental company
4. Proposed equipment rental rate is reasonable
5. The Engineer authorizes the equipment source and the rental rate before the Contractor uses the equipment

Equipment on the Job Site

For equipment on the job site at the time required to perform work paid by force account, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to move the equipment to another location on the job site when the work paid by force account is completed
2. To load and unload equipment

3. Equipment is operated to perform work paid by force account and:
    3.1. Hourly rates are paid in 1/2-hour increments
    3.2. Daily rates are paid in 1/2-day increments

Equipment Not On the Job Site Required for Original-Contract Work
For equipment not on the job site at the time required to perform work paid by force account and required for original-Contract work, the time paid is the time the equipment is operated to perform work paid by force account and the time to move the equipment to a location on the job site when the work paid by force account is completed.

The minimum total time paid is:
1. 1 day if daily rates are paid
2. 8 hours if hourly rates are paid

If daily rates are recorded, equipment:
1. Idled is paid as 1/2 day
2. Operated 4 hours or less is paid as 1/2 day
3. Operated 4 hours or more is paid as 1 day

If the minimum total time exceeds 8 hours and if hourly rates are listed, the City rounds up hours operated to the nearest 1/2-hour increment and pays based on the hours shown the following table. The table does not apply when equipment is not operated due to breakdowns, in which case rental hours are the hours the equipment was operated.

Equipment Rental Hours

Hours operated	Hours paid
0.0	4.00
0.5	4.25
1.0	4.50
1.5	4.75
2.0	5.00
2.5	5.25
3.0	5.50
3.5	5.75
4.0	6.00
4.5	6.25
5.0	6.50
5.5	6.75
6.0	7.00
6.5	7.25
7.0	7.5
7.5	7.75
≥8.0	hours used

Equipment Not On the Job Site Not Required for Original-Contract Work
For equipment not on the job site at the time required to perform work paid by force account and not required for original-Contract work, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to return the equipment to its source when the work paid by force account is completed

2. To load and unload equipment

3. Equipment is operated to perform work paid by force account

Non-Owner-Operated Dump Truck Rental
Submit the rental rate for non-owner-operated dump truck rental. The Engineer determines the payment rate. Payment for non-owner-operated dump truck rental is for the cost of renting a dump truck, including its driver. For the purpose of markup payment only, the non-owner-operated dump truck is rental equipment and the owner is a subcontractor.

The above markups shall constitute full compensation for all home office overhead, field office overhead, bond costs, profit, labor liability insurance, and other fixed or administrative costs that are not costs specifically designated as cost or equipment rental as stated above. The total payment made as provided above shall be deemed to be the actual cost of the work and shall constitute full compensation therefor.

When extra work to be paid for on a force account basis is performed by a subcontractor, approved in conformance with the provisions in Section 5-1.13, "Subcontracting," an additional markup of 2 percent will be added to the total cost of that extra work including all markups specified in this Section. The additional 2 percent markup shall reimburse the Contractor for additional administrative costs, and no other additional payment will be made by reason of performance of the extra work by a subcontractor.

17. Change Of Contract Time:
The contract time may only be changed by a contract change order. The value of any work covered by a contract change order for an adjustment in the contract time will be determined as follows:

(a) Additional working days will be awarded where the amount of time is mutually agreed upon by Contractor and Engineer; or

(b) Additional working days will be awarded where Contractor is prevented from completing any part of the work identified on the critical path and:

a. where the delay is caused by acts of public enemy, fire, floods, tsunamis, earthquakes, epidemics, quarantine restrictions, strikes, labor disputes, shortage of materials and freight embargos, provided that Contractor shall notify Engineer in writing of the causes of delay within 15 days from the beginning of that delay; or

b. where the delay is caused by actions beyond the control of Contractor; or

c. where the delay is caused by actions or failure to act by Engineer.

Contractor shall not be entitled to an adjustment in contract time for delays within the control of Contractor. Delays resulting from and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

18. Inspection And Testing Of Materials:
Contractor shall notify City a sufficient time in advance of the manufacture of production materials to be supplied by Contractor under this contract in order for City to arrange for mill or factory inspection and testing of same.

Any materials shipped by Contractor from factory prior to having satisfactorily passed such testing and inspection by City's representative or prior to the receipt of notice from such representative that such testing and inspection will not be required shall not be incorporated on the job of said improvement. Contractor shall also furnish City, in triplicate, certified copies of all factory and mill test reports upon request.

19. Permits And Care Of The Work:
Contractor has examined the site of the work and is familiar with its topography and condition, location of property lines, easements, building lines, and other physical factors and limitations affecting the performance of this agreement. Contractor, at Contractor's expense, shall obtain any

permission necessary for any operations conducted off the property owned or controlled by City. Contractor shall be responsible for the proper care and protection of all materials delivered and work performed until completion and final acceptance.

20. Other Contracts:

City may award other contracts for additional work, and Contractor shall fully cooperate with such other Contractors and carefully fit Contractor's own work to that provided under other contracts as may be directed by the City Engineer. Contractor shall not commit or permit any act which will interfere with the performance of work by any other Contractor.

21. Payments To Contractor:

Payments are to be made to the Contractor in accordance with the provisions of Section 9 of the General Conditions of said specifications in legally executed and regularly issued warrants of the city, drawn on the appropriate fund or funds as required by law and order of the City Council thereof. The Contractor shall be administered a progress payment approximately every 30 calendar days from the time work begins according to the payment schedule furnished by the City Engineer at the time work begins.

Monthly progress payments in the amount of 95 percent of the value of the work will be made to the Contractor based on this estimate and the schedule of prices contained in the accepted bid. The remaining 5 percent will be retained by the City as partial security for the fulfillment of the contract except that at any time after fifty (50) percent of the work has been completed, if the City Engineer finds that satisfactory progress is being made and the projects critical path of work are on schedule, the City may discontinue any further retention. Such discontinuance will only be made upon the written request of the Contractor. The City may, at any time the City Engineer finds that satisfactory progress is not being made, again institute retention of five (5) percent as specified above. Payment will be made as soon as possible after the preparation of the estimate.

No estimate or payment shall be made if, in the judgment of the City Engineer, the work is not proceeding in accordance with the provisions of the Contract, or when, in his judgment, the total value of the work done since the last estimate amounts to less than $1,000. No progress payments will be made if the time allotted for the job is 30 working days or less.

Additionally, as a precondition to City's progress payments hereunder, Contractor shall provide to City, prior to payment, unconditional waivers and releases of stop notices pursuant to Civil Code §8128 et seq. from each Subcontractor and materials supplier. The form of said waivers and releases shall be as set forth in Civil Code §3262(d)(2).

Pursuant to Division 2, Part 5, Section 22300, et seq., of the Public Contracts Code, the Contractor may request the right to substitute securities for any moneys withheld by the City of Turlock to ensure the performance required of the Contractor under the contract, or that the City of Turlock make payment of retentions earned directly into an escrow account established at the expense of the Contractor.

22. Contract Security:

Concurrently with the execution hereof, Contractor shall furnish on the forms provided (1) a surety bond in an amount equal to at least one hundred percent (100%) of the contract price as security for the faithful performance of this contract; and (2) a separate surety bond in an amount equal to at least one hundred percent (100%) of the contract price as security for the payment of all persons performing labor and furnishing materials in connection with this contract. Sureties on each of said bonds thereof shall be satisfactory to the City.

23. Indemnification:

Indemnity for Professional Liability: When the law establishes a professional standard of care for Contractor's Services, to the fullest extent permitted by law, Contractor shall indemnify, protect, defend, and hold harmless City and any and all of its elective and appointive boards, officers, officials, agents, employees or volunteers from and against any and all losses, liabilities, damages,

costs, and expenses, including legal counsel's fees and costs but only to the extent the Contractor (and its Subcontractors) are responsible for such damages, liabilities and costs on a comparative basis of fault between the Contractor (and its Subcontractors) and the City in the performance of professional services under this Agreement. Contractor shall not be obligated to defend or indemnify City for the City's own negligence or for the negligence of others.

Indemnity for other than Professional Liability: Other than in the performance of professional services and to the full extent permitted by law, Contractor shall indemnify, defend, and hold harmless City and any and all of its elective and appointive boards, officers, officials, agents, employees or volunteers from and against any liability (including liability for claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses or costs of any kind, whether actual, alleged or threatened, including legal counsel's fees and costs, court costs, interest, defense costs, and expert witness fees), where the same arise out of, are a consequence of, or are in any way attributable to, in whole or in part, the performance of this Agreement by Contractor or by any individual or agency for which Contractor is legally liable, including, but not limited to, officers, agents, employees, or subcontractors of Contractor.

24. Contractor's Insurance:

Contractor shall not commence work under this Agreement until Contractor has obtained City's approval regarding all insurance requirements, forms, endorsements, amounts, and carrier ratings, nor shall Contractor allow any subcontractor to commence work on a subcontract until all similar insurance required of the subcontractor shall have been so obtained and approved. Contractor shall procure and maintain for the duration of this Agreement insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by Contractor, its agents, representatives, employees or subcontractors. Failure to maintain or renew coverage or to provide evidence of renewal may constitute a material breach of contract. Any available insurance proceeds in excess of the specified minimum limits and coverage shall be available to City.

(a) General Liability Insurance: Contractor shall maintain commercial general liability insurance with coverage at least as broad as Insurance Services Office form CG 00 01, in an amount not less than two million dollars ($2,000,000) per occurrence, four million dollars ($4,000,000) general aggregate, for bodily injury, personal injury, and property damage, including without limitation, blanket contractual liability and coverage for explosion, collapse and underground property damage hazards. Contractor's general liability policies shall be primary and not seek contribution from the City's coverages, and be endorsed using Insurance Services Office form CG 20 10 to provide that City and its officers, officials, employees, and agents shall be additional insureds under such policies. For construction contracts, an endorsement providing completed operations to the additional insured, ISO form CG 20 37, is also required.

(b) Workers' Compensation Insurance: Contractor shall maintain Workers' Compensation Insurance (Statutory Limits) and Employer's Liability Insurance with limits of at least one million dollars ($1,000,000). Contractor shall submit to City, along with the certificate of insurance, a Waiver of Subrogation endorsement in favor of City, its officers, agents, employees, and volunteers.

(c) Auto Insurance: Contractor shall provide auto liability coverage for owned, non-owned, and hired autos using ISO Business Auto Coverage form CA 00 01, or the exact equivalent, with a limit of no less than two million dollars ($2,000,000) per accident. If Contractor owns no vehicles, this requirement may be met through a non-owned auto endorsement to the CGL policy.

(d) Builder's Risk Insurance: Upon commencement of construction and with approval of City, Contractor shall obtain and maintain Builder's Risk/Course of Construction insurance. Policy shall be provided for replacement value on an "all-risk" basis. The City shall be named as Loss Payee on the policy and there shall be no coinsurance penalty provision in any such

policy. Policy must include: (1) coverage for removal of debris, and insuring the buildings, structures, machinery, equipment, materials, facilities, fixtures, and all other properties constituting a part of the project; (2) coverage with limits sufficient to insure the full replacement value of any property or equipment stored either on or off the project site, whether provided from within a Builder's Risk policy or through the addition of an Installation Floater. Such insurance shall be on a form acceptable to City to ensure adequacy of terms and limits. Contractor shall not be required to maintain property insurance for any portion of the Project following transfer of control thereof to City.

(e) Contractors Pollution Insurance: Pollution Coverage shall be provided on a Contractors Pollution Liability form or other form acceptable to City providing coverage for liability arising out of sudden, accidental and gradual pollution and remediation. The policy limit shall be no less than one million dollars ($1,000,000) per claim. All activities contemplated in this Agreement shall be specifically scheduled on the policy as "covered operations." The policy shall provide coverage for the hauling of waste from the project site to the final disposal location, including non-owned disposal sites.

(f) Professional Liability Insurance: When applicable, Contractor shall maintain professional liability insurance that insures against professional errors and omissions that may be made in performing the Services to be rendered in connection with this Agreement, in the minimum amount of one million dollars ($1,000,000) per claim and in the aggregate. Any policy inception date, continuity date, or retroactive date must be before the effective date of this Agreement, and Contractor agrees to maintain continuous coverage through a period no less than three (3) years after completion of the services required by this Agreement.

(g) Deductibles and Self-Insured Retentions: Upon request of City, any deductibles or self-insured retentions must be declared to and approved by City. At the option of City, either: (1) the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects City, its elective and appointive boards, officers, agents, employees, and volunteers; or (2) Contractor shall provide a financial guarantee satisfactory to City guaranteeing payment of losses and related investigations, claim administration and defense expenses.

(h) Other Insurance Provisions: The commercial general liability policy shall contain, or be endorsed to contain, the following provisions:

(1) City, its elective and appointive boards, officers, agents, employees, and volunteers are to be covered as additional insureds with respect to liability arising out of work or operations performed by or on behalf of Contractor, including materials, parts or equipment furnished in connection with such work or operations, which coverage shall be maintained in effect for at least three (3) years following the completion of the work specified in the contract. General liability coverage can be provided in the form of an endorsement to Contractor's insurance (at least as broad as CG 20 10 for ongoing operations and CG 20 37 for products/completed operations), or as a separate Owners and Contractors Protective Liability policy providing both ongoing operations and completed operations coverage.

(2) For any claims related to this project, Contractor's insurance coverage shall be primary insurance as respects City and any insurance or self-insurance maintained by City shall be excess of Contractor's insurance and shall not contribute with it.

(3) In the event of cancellation, non-renewal, or material change that reduces or restricts the insurance coverage afforded to City under this Agreement, the insurer, broker/producer, or Contractor shall provide City with thirty (30) days' prior written notice of such cancellation, non-renewal, or material change.

(4) Coverage shall not extend to any indemnity coverage for the active negligence of the additional insured in any case where an agreement to indemnify the additional insured would be invalid under Subdivision (b) of Section 2782 of the Civil Code.

(i) Acceptability of Insurers: Insurance is to be placed with insurers with a current A.M. Best's rating of no less than A-:VII or with an insurer to which the City has provided prior approval.

(j) Verification of Coverage: Contractor shall furnish City with original certificates and amendatory endorsements or copies of the applicable policy language effecting coverage required by this clause. All certificates and endorsements are to be received and approved by City before work commences. However, failure to obtain the required documents prior to the work beginning shall not waive Contractor's obligation to provide them. City reserves the right, at any time, to require complete, certified copies of all required insurance policies and endorsements.

(k) Waiver of Subrogation: With the exception of professional liability, Contractor hereby agrees to waive subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. The commercial general liability policy and workers' compensation policy shall be endorsed to contain a waiver of subrogation in favor of City for all work performed by Contractor, its agents, employees, independent contractors and subcontractors. Contractor agrees to obtain any endorsement that may be necessary to effect this waiver of subrogation.

(l) Subcontractors: Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.

(m) Surety Bonds: Contractor shall provide a Performance Bond and a Payment Bond.

25. Proof Of Carriage Of Insurance:

Contractor shall furnish City concurrently with the execution hereof, satisfactory proof of carriage of the insurance required, and that Contractor shall give City at least sixty (60) days prior notice of the cancellation of any policy during the effective period of this contract.

26. Wages & Hours Of Employment:

In the performance of this contract, eight (8) hours shall be the maximum hours of labor on any calendar day, and the minimum wages of compensation of persons performing labor in the execution of this agreement shall be the current prevailing scale of wages determined by the Director of the Department of Industrial Relations for the community.

The Contractor shall forfeit as penalty to the City, Twenty-five and no/100ths Dollars ($25.00) to be paid to the City of Turlock for each workman employed in the execution of this agreement by him or by any subcontractor, for each calendar day during which any workman is required or permitted to labor more than eight (8) hours, in violation of provisions of Article 3, Chapter 1, Part 7, a Division 2, of the Labor Code of the State of California, and all amendments thereto.

27. Emergency - Additional Time For Performance - Procurement Of Materials:

If, because of war or other declared national emergency, the Federal or State Government restricts, regulates, or controls the procurement and allocation of labor or materials, or both, and if solely because of said restrictions, regulations or controls, Contractor is through no fault of the Contractor, unable to perform this agreement, or the work is thereby suspended or delayed, any of the following steps may be taken.

(a) City may, pursuant to resolution of the Council, grant Contractor additional time for the performance of this agreement, sufficient to compensate in time, for delay or suspension.

To qualify for such extension in time, Contractor within ten (10) days of Contractor's discovering such inability to perform, shall notify City Engineer in writing thereof, and give specific reasons therefore; City Engineer shall thereupon have sixty (60) days within which to procure such needed materials or labor as is specified in this agreement, or permit substitution, or provide for changes in the work in accordance with other provisions of this agreement.

Substituted materials, or changes in the work, or both, shall be ordered in writing by City Engineer, and the concurrence of the Council shall not be necessary. All reasonable expenses of such procurement incurred by the City Engineer shall be defrayed by the Contractor; or

(b) If such materials or labor cannot be procured through legitimate channels within sixty (60) days after the filing of the aforesaid notice, either party may, upon thirty (30) days' written notice to the other, terminate this agreement. In such event, Contractor shall be compensated for all work executed upon a unit basis in proportion to the amount of the work completed, or upon a cost-plus-ten-percent (10%) basis, whichever is the lesser. Materials on the ground, in process of fabrication or in route upon the date of notice of termination specially ordered for the project and which cannot be utilized by Contractor, shall be compensated for by City at cost, including freight, provided the Contractor shall take all steps possible to minimize this obligation; or

(c) City Council, by resolution, may suspend this agreement until the cause of inability to perform is removed but for a period of not to exceed sixty (60) days.

If this agreement is not canceled, and the inability of Contractor to perform continues without fault on Contractor's part, beyond the time during which the agreement may have been suspended, as herein above provided, City Council may further suspend this agreement, or either party hereto may, without incurring any liability, elect to declare this agreement terminated upon the ground of impossibility of performance. In the event City declares this agreement terminated, such declaration shall be authorized by the City Council by resolution, and Contractor shall be notified in writing thereof within five (5) days after the adoption of such resolution. Upon such termination, Contractor shall be entitled to proportionate compensation at the agreement rate for such portion of the agreement as may have been performed, or

(d) City may terminate this agreement, in which case Contractor shall be entitled to proportionate compensation at the agreed rate for such portion of the agreement as may have been performed. Such termination shall be authorized by resolution of the Council. Notice thereof shall be forthwith given in writing to Contractor, and this agreement shall be terminated upon receipt by Contractor of such notice.

In the event of the termination provided in this sub-paragraph (d), none of the covenants, conditions or provisions hereof shall apply to the work not performed, and City shall be liable to Contractor for the proportionate compensation last herein mentioned.

28. Provisions Cumulative:

The provisions of this agreement are cumulative, and in addition to and not in limitation of, any other rights or remedies available to City.

29. Taxes:

Contractor shall cooperate with City to the full extent possible to maximize the local allocation of California sales and use tax to the City. Such cooperation shall include but not be limited to:

(a) Use Tax Direct Payment Permits. Contractor shall apply for, obtain and utilize, to the maximum extent reasonable, a California Use Tax Direct Payment Permit.

(b) Purchases of $500,000 or More. Contractor shall require vendors and suppliers located outside California from whom Contractor makes purchase of $500,000 or more to allocate the use tax to the City.

Additional information regarding use tax and the Permit can be found in the State of California Board of Equalization, Sales and Use Tax Regulations, Regulation 1699.6, Use Tax Direct Payment Permits, or on the web site for the Board of Equalization at http://www.boe.ca.gov/sutax/sutprograms.htm

30. Notices:

All notices shall be in writing and delivered in person or transmitted by certified mail, postage prepaid.

Notices required to be given to City shall be addressed as follows:

City of Turlock
City Engineer
156 S. Broadway, Suite 150
Turlock, CA 95380-5461

Notices required to be given to Contractor shall be addressed as follows:

_____
_____
_____

Notices required to be given sureties of Contractor shall be addressed as follows:

_____
_____
_____
_____

31. CITY CONTRACT ADMINISTRATOR:

The City's contract administrator and contact person for this Agreement is:

Name of City Employee
Department
156 S. Broadway, Suite ___
Turlock, California 95380-5461
or 244 N. Broadway
Turlock, California 95380-4737
Telephone: (209) 668-_____
E-mail: _____@turlock.ca.us

32. Interpretation:

As used herein, any gender includes each other gender, the singular includes the plural and vice versa.

33. Antitrust Claims:

The Contractor or subcontractor offers and agrees to assign to the City all rights, title and interest to any causes of action under Section Four of the Clayton Act and the Cartwright Act concerning antitrust claims.

34. Use of City Project Number:

The Contractor or subcontractor agrees to use the aforementioned City project number on all maps, drawings, submittals, billing, and written correspondence that involve City staff or contracted

consultants. Nothing in this section shall preclude the Contractor or subcontractor from using their own project numbers for their own internal use.

IN WITNESS WHEREOF, three identical counterparts of this agreement, consisting of a total of 29 pages, each of which counterparts shall for all purposes be deemed an original of said agreement, have been duly executed by the parties hereinabove named, on the day and year first herein above written.

CONTRACTOR

By: _____

_____
Print Name

Address:_____
_____
_____
Phone: _____
Date: _____

Federal Tax ID or Social Security No:

_____

DIR Registration Number:

_____

Attach Contractor's Seal Here

CITY OF TURLOCK, a municipal corporation

By: _____
Gary Soiseth, Mayor
or
_____
Robert C. Lawton, City Manager

Date: _____

APPROVED AS TO SUFFICIENCY:

By: _____
Nathan Bray, Interim City Engineer

APPROVED AS TO FORM:

By: _____
Jose M. Sanchez, Interim City Attorney

ATTEST:

By: _____
Jennifer Land, City Clerk

WORKERS' COMPENSATION INSURANCE CERTIFICATION

Pursuant to Section 2.1 of the Contract, the Contractor certifies as follows:

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Signed: _____ Date: _____

_____
(Typed or Printed Name)

Business Address (Street Address, City, State & Zip Code):

_____

_____

_____

Business Phone: ( ) _____

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the **City of Turlock,** State of California, has awarded to _____, hereinafter designated as the "Principal," a contract for **Project No. 08-59 Well 8 GAC System Rehabilitation and Site Work;** and,

WHEREAS, said Principal is required under the terms of said contract to furnish a bond for the faithful performance of said contract.

NOW, THEREFORE, we the Principal, and _____ as Surety, are held and firmly bound unto the City of Turlock in the penal sum of _____ ($_____), lawful money of the United States for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if the above bounden Principal, or Principal's heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in said contract and any alteration thereof made as therein provided, on the Principal's part, to be kept and performed at the time and in the manner therein specified and in all respects according to their true intent and meaning; and shall defend, indemnify and save harmless the City of Turlock, its officers and agents as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and virtue.

And the Surety, for value received hereby stipulates and agrees that, in accordance with the Plans, Standard Specifications, Special Provisions, and other contract documents, no change, extension of time, alteration, or addition to the terms of the contract, or to the work to be performed hereunder, or to the specifications accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration of additions to the terms of the Contract to the work, or to the specifications.

The City reserves the right to refuse use of any Contractor assigned by any surety to complete the work.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their seals this _____day of _____, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

(Corporate Seal) **Principal** _____

By _____

Title _____

(Attach Notarial Acknowledgment)

(Corporate Seal) **Surety** _____

Address _____

Phone No.: ( )_____ Fax No.: ( ) _____

By _____
Attorneys-in-Fact

Title _____

(Attach Notarial Acknowledgment)

<u>NOTE TO SURETY COMPANY</u>: There must be submitted a certified copy of unrevoked resolution of authority for the attorneys-in-fact.

(Seal) **Witness** _____

Approved as to form:

_____
Risk Manager

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the **City of Turlock**, a municipal corporation, has awarded to _____, hereinafter designated as the "Principal", a contract for **Project No**. **18-59, "Well 8 GAC System Rehabilitation and Site Work"**; and

WHEREAS, said Principal is required to furnish a bond in connection with said contract, to secure payment of claims of laborers, mechanics, or materialmen employed on work under said contract, as provided by law.

NOW, THEREFORE, we the undersigned Principal and Surety are held and firmly bound unto the City of Turlock in the sum of _____ ($_____), said sum being equal to the estimated amount payable by said City of Turlock under the terms of the contract, for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that if said Principal, or Principal's heirs, executors, administrators, successors, or assigns, or subcontractors shall fail to pay for any material, provisions, provender, or other supplies, implements, or machinery used in, upon, for or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Code with respect to such work or labor, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board from these wages of employees of the Contractor and Contractor's subcontractors pursuant to the Revenue and Taxation Code, with respect to such work and labor, the Surety or Sureties hereon will pay for the same in an amount not exceeding the sum specified in this bond, otherwise the above obligation shall be void. In case suit is brought upon this bond, said Surety will pay a reasonable attorney's fee to be fixed by the court.

This bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under Section 3138 of the Civil Code of the State of California so as to give a right of action to them or their assigns in any suit brought upon this bond.

Said Surety, for value received, hereby stipulates and agrees that, in accordance with the Plans, Standard Specifications, Special Provisions, and other Contract Documents, no change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed there under, or to the specifications accompanying the same, shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work, or to the specifications.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their seals this_____day of _____, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

(Corporate Seal) **Principal** _____

By _____

Title _____

(Attach Notarial Acknowledgment)

(Corporate Seal) **Surety** _____

Address _____

Phone No.: ( )_____ Fax No.: ( ) _____

By _____
Attorneys-in-Fact

Title _____

(Attach Notarial Acknowledgment)

NOTE TO SURETY COMPANY: There must be submitted a certified copy of unrevoked resolution of authority for the attorneys-in-fact.

(Seal) **Witness** _____

Approved as to form:

_____
Risk Manager

ESCROW FOR SECURITY DEPOSIT

IN LIEU OF RETENTION

This Escrow Agreement is made and entered into by and between the **City of Turlock**, whose address is 156 S. Broadway, Turlock, CA, 95380, hereinafter called "City",_____, whose address is _____, hereinafter called "Contractor", and _____, whose address is _____, hereinafter called "Escrow Agent."

For the consideration hereinafter set forth, the City, Contractor, and Escrow Agent agree as follows:

1. Pursuant to Section 22300 of the Public Contract Code of the State of California, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by City pursuant to the construction contract entered into between the City and Contractor for **Project No. 18-59, Well 8 GAC System Rehabilitation and Site Work** in the amount of _____ dated _____ (hereinafter referred to as the "Contract"). Alternatively, on written request of the Contractor, the City shall make payments of the retention earnings directly to the Escrow Agent. When Contractor deposits the securities as substitute for Contract earnings, the Escrow Agent shall notify the City within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract amount between the City and Contractor. Securities shall be held in the name of _____, and shall designate the Contractor as the beneficial owner.

   The Contractor shall select and initial one of the following options:

2. [ ] The City shall make progress payments to the Contractor for such funds that otherwise would be withheld from progress payments pursuant to the Contract provisions, provided that the Escrow Agent holds securities in the form and amount specified above,

   OR

3. [ ] The City shall make payment of retentions earned directly to the Escrow Agent. The Escrow Agent shall hold them for the benefit of the Contractor until such time as the escrow created under this Contract is terminated. The Contractor may direct the investments of the payments into securities. All terms and conditions of this agreement and the rights and responsibilities of the parties shall be equally applicable and binding when the City pays the Escrow Agent directly.

4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account and all expenses of the City. These expenses and payment terms shall be determined by the City, Contractor, and Escrow Agent.

5. The interest earned on the securities or the money market accounts held in escrow and all interest earned shall be for the sole use of the Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to the City.

6. Contractor shall have the right to withdraw all or any part of the principal in the escrow account only by written notice to Escrow Agent accompanied by written authorization from City to the Escrow Agent that City consents to the withdrawal of the amount sought to be withdrawn by Contractor.

7. The City shall have a right to draw upon the securities in the event of default by the Contractor. Upon seven day's written notice to the Escrow Agent from the City of the default, the Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by the City.

8. Upon receipt of written notification from the City certifying that the Contract is final and complete, and that the Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and

charges of the escrow account. The escrow shall be closed immediately upon disbursement of all monies and securities on deposit and payments of fees and charges.

9. Escrow Agent shall rely on the written notifications from the City and the Contractor pursuant to Sections (5) to (8) inclusive, of this agreement and the City and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of the securities and interest as set forth above.

10. Contractor authorizes the Escrow Agent to issue monthly statements of the status of the funds held in the escrow account to the City. Escrow Agent shall issue said statements on a monthly basis and mail to: City of Turlock, ATTN: Finance Department, 835 East 14th Street, Turlock, CA 94577.

11. The names of the persons who are authorized to give written notice or to receive written notice on behalf of the City and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures, are as follows:

On behalf of City:

Title

Name

On behalf of Contractor:

Title

Name

On behalf of Escrow Agent:

Title

Name

Signature

Address

At the time the escrow account is opened, the City and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this agreement.

IN WITNESS WHEREOF, the parties have executed this agreement by their proper officers on the date first set forth above.

City:	**Contractor:**
_____	_____
Title	Title
_____	_____
Name	Name
_____	_____
Signature	Signature
_____	_____
Address	Address

SPECIAL PROVISIONS

City Project No. 18-59
Well 8 GAC System Rehabilitation and Site Work

SECTION 1 - SPECIFICATIONS AND PLANS

SPECIAL NOTES:

1. Official bid documents including plans and specifications are available online at http://www.CityofTurlock.org/capitalprojects. All bids submitted for this project must conform to the requirements of the official bid documents, including plans and specifications.
2. Contractor's attention is drawn to Section 5.18 "Order of Work" of these Special Provisions.
3. The City has not secured a staging yard for this project. The Contractor shall secure their own staging yard if the Well 8 site is insufficient. Prior to occupying property not owned by the Contractor, Contractor shall furnish a signed agreement between property owner and Contractor stating terms of use for property.

1.01 SPECIFICATIONS:

The work described herein shall be done in accordance with the current City of Turlock Standard Specifications and the 2010 Edition of the State of California, Department of Transportation Standard Specifications and Standard Plans (with exception that English units are to be used in place of metric) and in accordance with the following Special Provisions.

The Contract Documents are complementary; what is required by one is as binding as if required by all.

It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to City.

Clarifications and interpretations of the Contract Documents shall be issued by Engineer.

in case of conflict or discrepancy between any of the Contract Documents, the order of documents listed below shall be the order of precedence, with the first item listed having the highest precedence.

1. Contract Change Order (Modifications or changes last in time are first in precedence).
2. Addenda to Contract Agreement
3. Contract Agreement
4. Permits
5. Special Provisions
6. Notice Inviting Bids and Instructions to Bidders
7. Project Drawings
8. City of Turlock Standard Specifications
9. Caltrans Standard Specifications
10. City of Turlock Standard Drawings
11. Caltrans Standard Plans

With regards to discrepancies or conflicts between written dimensions given on drawings and the scaled measurements, the written dimensions shall govern.

With regards to discrepancies or conflicts between large-scale drawings and small-scale drawings, the larger scale shall govern.

With regards to discrepancies or conflicts between detailed drawings and referenced standard drawings or plans, the detailed drawings shall govern.

In the event where provisions of codes, safety orders, contract documents, referenced manufacturer's specifications or industry standards are in conflict, the more restrictive and higher quality shall govern.

Should it appear that the work to be done or any of the matters relative thereto are not sufficiently detailed or explained in these specifications, the special provisions, or the plans, the Contractor shall apply to the Engineer in writing for such further explanations as may be necessary and shall conform to them as part of the contract. All responses from the Engineer shall also be in writing. In the event of any doubt or question arising respecting the true meaning of these specifications, the special provisions or the plans, reference shall be made to the Engineer, whose decision thereon shall be final.

1.02 CONTRACTOR'S RESPONSIBILITY:

The Contractor shall examine carefully the site of the work and the plans and specifications therefore. The Contractor shall investigate to their satisfaction as to conditions to be encountered, the character, quality and quantity of surface, subsurface materials or obstacles to be encountered, the work to be performed, materials to be furnished, and as to the requirements of the bid, plans and specifications of the contract.

1.03 COMPLETENESS AND ACCURACY OF PLANS AND SPECIFICATIONS:

Pursuant to the California Public Contract Code, the bidder is required to review architectural or engineering plans and specifications prior to submission of a bid, and report any errors and omissions noted by Contractor to the architect, engineer or owner five days prior to the bid opening date.

SECTION 2 - PROPOSAL REQUIREMENTS AND CONDITIONS

2.01 GENERAL:

The Contractor's attention is directed to the "Notice to Contractor" for the date, time and location of the mandatory Pre-Bid meeting, if applicable.

The bidder's attention is directed to the provisions in Proposal for this bid for the requirements and conditions which the bidder must observe in the preparation of and the submission of the bid.

The Contractor shall acknowledge on the bid form with signature of all addendums issued. Failure to acknowledge by signature may result in determining the bid unresponsive.

The bidder's bond shall conform to the bond form in the Bid book for the project and shall be properly filled out and executed. The bidder's bond form included in that book must be used.

in conformance with Public Contract Code Section 7106, a Noncollusion Affidavit is included in the Bid book. Signing the Bid book shall also constitute signature of the Noncollusion Affidavit.

The contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of Title 49 CFR (Code of Federal Regulations) part 26 in the award and administration of US DOT assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the recipient deems appropriate. Each subcontract signed by the bidder must include this assurance.

Failure of the bidder to fulfill the requirements of the Special Provisions for submittals required to be furnished after bid opening, including but not limited to escrowed bid documents, where applicable, may subject the bidder to a determination of the bidder's responsibility in the event it is the apparent low bidder on a future public works contracts.

2.02 EXISTING UTILITIES, FACILITIES, AND SITE CONDITIONS:

The actual sizes, locations and materials of existing utilities and facilities shown on the plans may vary from what is shown on the plans. Attention is directed to the possible existence of underground facilities not indicated on the plans or in the special provisions. Contractor shall be responsible for verifying the locations

and nature of the existing utilities, protecting them from damage and notifying Engineer of their location and nature.

Contractor shall examine carefully the site of the work. It is assumed that Contractor has investigated and is satisfied as to the conditions to be encountered as to the character, quality and quantities of work to be performed.

Although the City of Turlock's soil conditions are homogenous and sandy in nature, various subsurface conditions such as hardpan, and ground water may be encountered. The City of Turlock will not be held responsible in any way for the type and character of subsurface conditions encountered. If a subsurface report is desired by Contractor, it will be Contractor's responsibility and expense to verify the subsurface conditions by boring or other means necessary prior to bidding and/or performing work. Attention is directed to Section 5.17, "Preservation of Property," of these special provisions during boring and other miscellaneous operations.

Full compensation for furnishing all labor, materials, tools, equipment (including dewatering devices), and incidentals, and for doing all the work involved with and/or in verifying existing utilities, facilities, site and subsurface conditions as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

2.03 ESCROW BID DOCUMENTS

1. SCOPE

The lowest Bidder, whose bid is deemed responsive, shall submit, within the specified time after receipt of Bids, one copy of all documentary information generated in preparation of Bid prices for this Project. This material is hereinafter referred to as "Escrow Bid Documents." The Escrow Bid Documents of the Successful Bidder will be held in escrow for the duration of the contract.

The Successful Bidder agrees, as a condition of award of the contract, that the Escrow Bid Documents constitute the complete, only, and all documentary information used in preparation of his Bid. No other Bid preparation information shall be considered in resolving disputes.

Nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract Documents.

2. OWNERSHIP

The Escrow Bid Documents are, and shall always remain, the property of CONTRACTOR, subject only to joint review by CITY and CONTRACTOR, as provided herein.

CITY stipulates and expressly acknowledges that the Escrow Bid Documents, as defined herein, constitute trade secrets. This acknowledgment is based on CITY's express understanding that the information contained in the Escrow Bid Documents is not known outside the Bidder's business, is known only to a limited extent and only by a limited number of employees of the Bidder, is safeguarded while in Bidder's possession, is extremely valuable to Bidder, and could be extremely valuable to Bidder's competitors by virtue of it reflecting Bidder's contemplated techniques of construction. CITY acknowledges that the Bidder expended substantial sums of money in developing the information included in the Escrow Bid Documents and further acknowledges that it would be difficult for a competitor to replicate the information contained therein. CITY further acknowledges that the Escrow Bid Documents and the information contained therein are made available to CITY only because such action is an express prerequisite to award of the contract. CITY further acknowledges that the Escrow Bid Documents include a compilation of information used in the Bidder's business, intended to give the Bidder an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. CITY agrees to safeguard the Escrow Bid Documents, and all information contained therein, against disclosure to the fullest extent permitted by law.

3. PROGRAM

Escrow Bid Documents will be used to assist in the negotiation of price adjustments and Change Orders and in the settlement of disputes, claims, and other controversies. They will not be used for pre-award evaluation

of CONTRACTOR's anticipated methods of construction or to assess CONTRACTOR's qualifications for performing the Work.

4. FORMAT AND CONTENTS

Bidders may submit Escrow Bid Documents in their usual cost estimating format. It is not the intention of this section to cause the Bidder extra work during the preparation of the Bid, but to ensure that the Escrow Bid Documents will be adequate to enable complete understanding and proper interpretation for their intended use. The Escrow Bid Documents shall be in the language of the Specifications.

The Escrow Bid Documents shall include all quantity takeoffs; crew; equipment; calculations of rates of production and progress; copies of quotations from equipment manufacturers, Subcontractors, and Suppliers; and memoranda, narratives, consultants' reports, add/deduct sheets, and all other information used by the Bidder to arrive at the prices contained in the Bid Form. Estimated costs should be broken down into the Bidder's usual estimate categories, such as direct labor, repair labor, equipment operation, equipment ownership, expendable materials, permanent materials, and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the Bidder's usual format. CONTRACTOR's allocation of plant and equipment, indirect costs, contingencies, markup, and other items to each Bid item shall be included.

Bidding Documents provided by the CITY should not be included in the Escrow Bid Documents unless needed to comply with the requirements of this section.

5. SUBMITTAL

The Escrow Bid Documents shall be submitted in a sealed container within five working days, as requested in writing from the City. The container shall be clearly marked on the outside with the Bidder's name, date of submittal, project name, and the words "Escrow Bid Documents."

The Escrow Bid Documents shall be accompanied with a certification signed by an individual authorized by the Bidder to execute the Bid Form, stating that the material in the Escrow Documentation constitutes the complete, only, and all documentary information used in preparation of the Bid and that he has personally examined the contents of the Escrow Bid Documents container and has found that the documents in the container are complete.

Prior to award, Escrow Bid Documents of the apparent Contractor will be unsealed, examined, organized, and inventoried by representatives of CITY, together with members of CONTRACTOR's staff who are knowledgeable in how the Bid was prepared. This examination is to ensure that the Escrow Bid Documents are authentic, legible, and complete. It will not include review or approval of proposed construction methods, estimating assumptions or interpretations of Contract Documents. This examination is subject to the condition that, as trade secrets, the Escrow Bid Documents are proprietary and confidential as described in Paragraph 2. Examination will not alter any condition(s) or term(s) of the contract.

If all the documentation required in Part 4, "Format and Contents," has not been included in the original submittal, additional documentation shall be submitted, at CITY's discretion, prior to award of the contract. The detailed breakdown of estimated costs shall be reconciled and revised, if appropriate, by agreement between CONTRACTOR and CITY before making the award.

If the contract is not awarded to the apparent Successful Bidder, the Escrow Bid Documents of the Bidder next to be considered for award shall be processed as described above.

Timely submission of complete Escrow Bid Documents is an essential element of the Bidder's responsibility and a prerequisite to contract award. Failure to provide the necessary Escrow Bid Documents will be sufficient cause for CITY to reject the Bid.

If the Bidder's proposal is based on subcontracting any part of the Work, each Subcontractor whose total subcontract price exceeds 5 percent of the total Contract Price proposed by the Bidder shall provide separate Escrow Bid Documents to be included with those of the Bidder. These documents will be opened

and examined in the same manner and at the same time as the examination described above for the apparent Successful Bidder.

If CONTRACTOR subcontracts any portion of the Work after award, CITY retains the right to require CONTRACTOR to submit Escrow Bid Documents from the Subcontractor before the subcontract is approved.

Escrow Bid Documents submitted by unsuccessful Bidders will be returned unopened, unless opened as provided above, as soon as they are no longer needed by CITY and no later than immediately following award of the contract.

6. STORAGE

The Escrow Bid Documents of the Contractor will be placed in escrow prior to award of the contract, for the life of the contract, in a mutually agreeable institution. The cost of storage will be paid by CITY.

7. EXAMINATION AFTER AWARD OF CONTRACT

The Escrow Bid Documents shall be examined by both CITY and CONTRACTOR, at any time deemed necessary after award of the contract by either CITY or CONTRACTOR, to assist in the negotiation of price adjustments and Change Orders, or the settlement of disputes.

Examination of the Escrow Bid Documents after award of the contract is subject to the following conditions:

A. As trade secrets, the Escrow Bid Documents are proprietary and confidential as described in Paragraph 2.

B. CITY and CONTRACTOR shall each designate, in writing to the other party and a minimum of 10 days prior to examination, representatives who are authorized to examine the Escrow Bid Documents. No other person shall have access to the Escrow Bid Documents.

C. Access to the Escrow Bid Documents will take place only in the presence of duly designated representatives of both CITY and CONTRACTOR.

8. FINAL DISPOSITION

The Escrow Bid Documents will be returned to CONTRACTOR at such time as the contract has been completed and final settlement has been achieved.

SECTION 3 - AWARD AND EXECUTION OF CONTRACT

3.01 GENERAL:

The Contractor's attention is directed to the provisions in the Contract for the requirements and conditions concerning award and execution of contract.

The contract shall be executed by the successful bidder and shall be returned, together with the contract bonds and insurance, to the City so that it is received within 10 working days after the bidder has received the contract for execution. Failure to do so shall be just cause for forfeiture of the proposal guaranty. The executed contract documents shall be delivered to the following address:

Attention: Tania Hernandez
City of Turlock, Engineering Division
156 S Broadway, Suite 150
Turlock, CA 95380

3.02 BID PROTEST:

Bid protests are due in writing by the seventh calendar day after the bid opening and are to be delivered to the following address:

Nathan Bray, PE
156 S Broadway Suite 150
Turlock, CA 95380

Bid protest must be submitted with a non-refundable fee of $250.00 to review and respond to the repost.

The Low Bidder shall respond to the bid protest upon notification by the Engineer.

The award of the contract, if it be awarded, will be to the lowest responsible bidder whose bid complies with all the requirements prescribed.

SECTION 4 - BEGINNING OF WORK, TIME OF COMPLETION AND DELAY DAMAGES

Attention is directed to Section 6 “Time For Performance” of the Agreement.

At no time shall construction begin prior to the issuance of the Notice to Proceed. Any work performed prior to the Notice to Proceed shall be done at the Contractor’s own risk and payment will not be made therefor.

The Contractor shall follow the sequence of construction and progress of work as specified in Section 5.18, “Order of Work,” of these Special Provisions.

Should the Contractor choose to work on a Saturday, Sunday or Legal Holiday as defined in Section 5.11 “Working Hours,” of these Special Provisions, the Contractor shall reimburse the City of Turlock the actual cost of engineering, inspection, testing, superintendent, and/or other overhead expenses which are directly chargeable to the contract. Should such work be undertaken at the request of the City, reimbursement will not be required.

Attention is directed to Section 9 “Delay Damages” of the Agreement.

A pre-construction meeting will be held between Contractor and City prior to the beginning of construction. The exact time and place of this conference will be determined by City after award of the construction contract.

City shall furnish to Contractor five hard copies of the Contract Documents and plans. Contractor may produce additional copies as needed at Contractor’s expense.

SECTION 5 - GENERAL

5.01 LABOR NONDISCRIMINATION:
Attention is directed to the following Notice that is required by Chapter 5 of Division 4 of Title 2, California Code of Regulations.

NOTICE OF REQUIREMENT FOR NONDISCRIMINATION PROGRAM
(GOV. CODE, SECTION 12990)

Your attention is called to the "Nondiscrimination Clause", set forth in Section 7 1.01A(4), "Labor Nondiscrimination," of the Caltrans Standard Specifications, which is applicable to all nonexempt state contracts and subcontracts, and to the "Standard California Nondiscrimination Construction Contract Specifications" set forth therein. The Specifications are applicable to all nonexempt state construction contracts and subcontracts of $5,000 or more.

5.02 PREVAILING WAGE:
Attention is directed to Section 7-1.02K "Labor Code," of the Caltrans Standard Specifications.

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county Stanislaus in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at 156 S. Broadway St, Turlock, CA 95380 and available from the California Department of Industrial Relations' Internet web site at http://www.dir.ca.gov/DLSR/PWD

5.03 REMOVAL OF ASBESTOS AND HAZARDOUS SUBSTANCES:

When the presence of asbestos or hazardous substances are not shown on the plans or indicated in the specifications and the Contractor encounters materials which the Contractor reasonably believes to be asbestos or a hazardous substance as defined in Section 25914.1 of the Health and Safety Code, and the asbestos or hazardous substance has not been rendered harmless, the Contractor may continue work in unaffected areas reasonably believed to be safe. The Contractor shall immediately cease work in the affected area and report the condition to the Engineer in writing.

in conformance with Section 25914.1 of the Health and Safety Code, removal of asbestos or hazardous substances including exploratory work to identify and determine the extent of the asbestos or hazardous substance will be performed by separate contract.

If delay of work in the area delays the current controlling operation, the delay will be considered a right of way delay and the Contractor will be compensated for the delay in conformance with the provisions in Section 8 1.07, "Delays," of the Caltrans Standard Specifications.

5.04 SUBCONTRACTING:

No subcontract releases the Contractor from the contract or relieves the Contractor of their responsibility for a subcontractor's work.

If the Contractor violates Pub Cont Code § 4100 et seq., the City may exercise the remedies provided under Pub Cont Code § 4110. The City may refer the violation to the Contractors State License Board as provided under Pub Cont Code § 4111.

Each subcontract must comply with the contract.

Each subcontractor must have an active and valid State contractor's license with a classification appropriate for the work to be performed (Bus & Prof Code, § 7000 et seq.).

At the pre-construction meeting, prior to starting work, Contractor shall submit a complete listing of subcontractors and the value of the work each subcontractor will perform. This list shall contain all information identified on Exhibit 12-G of the Local Assistance Procedures Manuel.

Before subcontracted work starts, submit a Subcontracting Request form.

Do not use a debarred contractor; a current list of debarred contractors is available at the Department of Industrial Relations' Web site.

Upon request by the Engineer, immediately remove and not again use a subcontractor who fails to prosecute the work satisfactorily.

5.05 PROMPT PROGRESS PAYMENT TO SUBCONTRACTORS:

A prime contractor or subcontractor shall pay any subcontractor not later than 10 days of receipt of each progress payment in accordance with the provision in Section 7108.5 of the California Business and Professions Code concerning prompt payment to subcontractors. The 10 days is applicable unless a longer period is agreed to in writing. Any delay or postponement of payment over 30 days may take place only for good cause and with the agency's prior written approval. Any violation of Section 7108.5 shall subject the violating contractor or subcontractor to the penalties, sanction and other remedies of that section. This requirement shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to the contractor or subcontractor in the event of a dispute involving late payment or

nonpayment by the prime contractor, deficient subcontract performance, or noncompliance by a subcontractor.

5.06 PROMPT PAYMENT OF FUNDS WITHHELD TO SUBCONTRACTORS:
The agency shall hold retainage from the prime contractor and shall make prompt and regular incremental acceptances of portions, as determined by the agency, of the contract work, and pay retainage to the prime contractor based on these acceptances. The prime contractor, or subcontractor, shall return all monies withheld in retention from a subcontractor within 30 days after receiving payment for work satisfactorily completed and accepted including incremental acceptances of portions of the contract work by the agency. Federal law (49CFR26.29) requires that any delay or postponement of payment over 30 days may take place only for good cause and with the agency's prior written approval. Any violation of this provision shall subject the violating prime contractor or subcontractor to the penalties, sanctions and other remedies specified in Section 7108.5 of the Business and Professions Code. These requirements shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to the prime contractor or subcontractor in the event of a dispute involving late payment or nonpayment by the prime contractor, deficient subcontract performance, or noncompliance by a subcontractor.

5.07 PAYMENTS:
Attention is directed to Section 21, "Payments to Contractor," of the Agreement.

At the end of each month the Contractor shall submit a proposed progress invoice. The invoice shall delineate each bid item, the amount of work performed for the invoice period (previous month) and the total amount of work performed to date. A sample invoice with all of the required items will be given to the Contractor at the pre-construction meeting.

The Engineer will review the progress invoice and after any changes the Engineer makes, will issue an official invoice for the Contractor to sign. The Contractor shall sign the official invoice and return to the Engineer. After the Engineer receives the signed, official invoice, the progress payment will be processed.

Retention in the amount of 5% of the progress payment amount shall be held from all progress payments. Retention will be released 35 days after the Notice of Completion has been filed, insofar as no stop notices were filed.

5.08 GUARANTY:
Attention is directed to Section 9-4, "Guaranty," of the City of Turlock Standard Specifications.

5.09 PUBLIC SAFETY:
in addition to any other measures taken by Contractor pursuant to the provisions of the Standard Specifications and the General Conditions, Contractor shall install temporary precast concrete barrier rail between any lane carrying public traffic and any excavation, obstacle or storage area when the following conditions exist:

Excavations: Any excavation, the near edge of which is 12 feet or less from the edge of the lane, except;

(a) Excavations covered with sheet steel or concrete covers of adequate thickness to prevent accidental entry by traffic or the public.

(b) Excavations less than one foot deep.

(c) Trenches less than one foot wide for irrigation pipe or electrical conduit or excavations less than one foot in diameter.

(d) Excavations parallel to the lane for the purpose of pavement widening or reconstruction.

(e) Excavations in side slopes where the slope is steeper than 4:1.

(f) Excavations protected by existing barrier or railing.

At the end of each working day, if a difference of 0.50 feet exists between the elevation of the existing pavement and the elevation of any excavation within 2 feet of the traveled way, material shall be placed and compacted against the vertical cuts adjacent to the traveled way. During excavation operations, native material may be used for this purpose, however, once the placing of the structural section commences, structural material shall be used. The material shall be placed to the level of the elevation of the top of the existing pavement and tapered at a slope of 4:1 or flatter to the bottom of the excavation. Treated base shall not be used for the taper. Full compensation for placing the material on a 4:1 slope, regardless of the number of times it is required, and subsequent removing or reshaping of the material to the lines and grades shown on the plans shall be considered as included in the cost for other contract items of work and no additional compensation will be allowed therefore.

Personal vehicles of Contractor's employees shall not be parked on the traveled way or shoulders, including any section closed to public traffic. Whenever vehicles or equipment are parked on the shoulder within 6 feet of a traffic lane, the shoulder area shall be closed with traffic cones or portable delineators placed on a taper in advance of the parked vehicles or equipment and along the edge of the pavement at 25 foot intervals to a point not less than 25 feet past the last vehicle or piece of equipment.

A minimum of one paved traffic lane, not less than 12 feet wide, shall be open for use by public traffic in each direction of travel. The full width of the traveled way shall be open for use by public traffic on Saturdays, Sundays and designated legal holidays, after 4:00 p.m. on Fridays and the day preceding designated legal holidays and when construction operations are not actively in progress.

5.10 SOUND CONTROL REQUIREMENTS:

Sound control shall be in accordance with Section 7 1.01I, “Sound Control Requirements,” of the Caltrans Standard Specifications and these special provisions.

The noise level from Contractor's operations, between the hours of 9:00 p.m. and 6:00 a.m., shall not exceed 86 dba at a distance of 50 feet. This requirement in no way relieves Contractor from responsibility for complying with local ordinances regulating noise level.

Said noise level requirements shall apply to all equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by Contractor. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety law for the protection of personnel.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

5.11 WORKING HOURS:

Contractor's working hours shall be between 7:00 a.m. and 5:00 p.m., Monday through Friday, excluding legal holidays.

Contractor shall notify Engineer 48 hours prior to beginning work.

Contractor shall not work outside the above-mentioned working hours without prior written consent of Engineer.

Designated legal holidays are: January 1st, the third Monday in January, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, the day after Thanksgiving, and December 25th. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When a designated legal holiday falls on a Saturday, the preceding Friday shall be a designated legal holiday.

5.12 UNDERGROUND SERVICE ALERT REQUIREMENTS:
Contractor shall contact Underground Service Alert of Northern California at least 48 hours in advance of any construction activity, will or could damage or affect any underground utility or subsurface improvement, and obtain an inquiry identification number. Contractor shall notify Underground Service Alert in the event of change in the project limits or change in original work previously shown on the plans or indicated in the specifications. Contractor shall not commence construction prior to City Inspector receiving City's notice from USA North regarding this construction activity.

5.13 DUST CONTROL:
Dust Control shall conform to the provisions in Section 10, “Dust Control”, of the Standard Specifications and these special provisions.

Full compensation for Dust Control will be considered as included in the various contract items of work requiring Dust Control, as determined by Engineer, and no separate payment will be made therefor.

5.14 WATERING:
Watering shall be in accordance with Section 17, “Watering,” of the Caltrans Standard Specifications.

Full compensation for Watering will be considered as included in the various contract items of work requiring Watering, as determined by Engineer, and no separate payment will be made therefor.

5.15 USE OF HYDRANTS FOR CONSTRUCTION PURPOSES:
City will permit the use of a hydrant for construction purposes provided that the following are abided by:

1. A spanner wrench shall be the only type of wrench used on fire hydrants.
2. Contractor shall be liable for the damages to or loss of all hydrants and associated water lines and equipment which result from the use of this equipment.
3. Water shall only be used within City limits.
4. The vehicle must be approved by Engineer for approved backflow device.
5. Contractor shall pay a deposit on a water meter provided by the City. After the project ended the Contractor shall return the meter to the City for the release of the deposit.

However, use of City hydrants does not exempt Contractor from providing a water truck where hydrants cannot be utilized due to unsafe working conditions as deemed by Engineer.

5.16 PROGRESS SCHEDULE:
Contractor shall furnish City with a Critical Path Method progress schedule. The progress schedule shall show the construction activities extending for the duration of the working days. Any deviation from the outline must be approved by Engineer. Contractor shall not be allowed to start construction activities until the progress schedule is accepted by Engineer.

Contractor shall furnish one copy of scheduling software for use by Engineer. Software shall be MS Project, SureTrak, or equal. Software shall remain with Engineer after completion of contract.

5.17 PRESERVATION OF PROPERTY:
The work performed in connection with various existing facilities shall be in accordance with Section 7-8, “Preservation of Property,” of the Standard Specifications and these special provisions.

Due care shall be exercised to avoid injury or damage to existing improvements or facilities, utility facilities, adjacent property, and roadside trees, shrubs and other plants that are to remain in place.

Roadside trees, shrubs and other plants that are not to be removed and pole lines, fences, signs, markers and monuments, buildings and structures, conduits, pipelines under or above aground, sewer and water lines, sprinkler systems above or below ground, all roadway facilities, and any other improvements or facilities within or adjacent to the right-of-way shall be protected from injury or damage, and if ordered by Engineer, Contractor shall provide and install suitable safeguards, approved by Engineer, to protect such objects from injury or damage. If such objects are injured or damaged by reason of Contractor's operations

they shall be replaced or restored at Contractor's expense. The facilities shall be replaced or restored to a condition as good or better as when Contractor entered upon the work, or as good as required by the specifications accompanying the contract, if any such objects are a part of the work being performed under the contract. Engineer may make or cause to be made such temporary repairs as necessary to restore to service any damaged facility. The cost of such repairs shall be borne by Contractor and may be deducted from any moneys due or to become due to Contractor under the contract.

The fact that any underground facility is not shown upon the plans shall not relieve Contractor of his responsibility under Section 2.02, “Existing Utilities and Facilities”, of these provisions. It shall be Contractor's responsibility, pursuant thereto, to ascertain the location of such underground improvements or facilities that may be subject to damage by reason of his operations.

Full compensation for furnishing all labor materials, tools, equipment, and incidentals, and for doing all the work involved in protecting or repairing property as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

5.18 ORDER OF WORK:

The project consists of several loosely connected elements. In general, the Contractor shall determine the schedule of construction for each element. However, the complete system (new pump, refurbished GAC vessels, chemical systems, and new valves and piping) must be finished to the point that normal operations can be initiated within 2 weeks of final disinfection. If this schedule cannot be met, the vessels and piping will be completely disinfected and sampled again at the Contractor’s expense every 2 weeks until the system begins normal operations.

To facilitate this schedule, the Contractor must notify the City at least 3 weeks prior to needing carbon delivered to the site. If carbon delivery is delayed due to conditions outside the Contractor’s control to a point where the system cannot be operational 2 weeks from disinfection and confirmation testing, the vessels and piping shall still be disinfected by the Contractor at the Owner’s expense.

5.19 AS-BUILTS:

When the job is complete, Contractor shall provide City with as-built drawings. These as-built drawings shall show any and all differences (revisions, additions, etc.) between the signed improvement plans and the installed improvements. The Contractor shall identify all utilities that are located in the field. The as-builts will consist of redlined signed improvement plans. The NOC will not be issued until acceptable as-builts have been received by the Engineer.

5.20 SURVEYING:

Construction survey staking shall be provided by City. Contractor shall provide a staking request no less than 1 week prior to Contractor starting work and not less than 48 hours before the staking is required to continue construction. The Contactor shall provide unimpeded access to the site and allow City survey crew to perform their work.

Contractor shall protect all survey stakes and markers during construction. If survey stakes and/or markers are damaged or destroyed during the course of construction, by vandalism or by any other means, Contractor may submit a request to have the survey re-staked. If re-staking is required, Contractor shall be back charged at the fully burdened hourly rate for the survey crew and shall fully reimburse City for all necessary materials and equipment.

5.21 TESTING:

Unless otherwise noted, City of Turlock will supply all acceptance testing. Coordination of said testing is the responsibility of Contractor through the project’s inspector. The Contractor shall provide at least 24 hours’ notice to the Engineer in advance of needing acceptance testing. If the Contractor request testing and the Contractor is not ready for the testing to occur, the Contractor shall be back charged the cover the cost of the testing firm.

At sites chosen by the project inspector, City's testing laboratory will conduct all tests. Contractor shall supply any necessary equipment and or labor required to obtain all samples for the completion of the testing process.

City of Turlock shall compensate the testing laboratory for all initial tests. Secondary and all other follow-up tests required due to failure of initial testing shall be reimbursed to City of Turlock based on the following schedule:

Water sample test: $300.00 Per Test
Compaction test: $100.00 Per Test

5.22 SUBMITTALS:

Before making submittals, Contractor shall ensure that products and materials will be available in the quantities and in the time required by the Contract and the approved outline of construction activity. Each submittal shall clearly identify, by highlighting, arrows or other defined and permanent mark, the products and materials proposed for use.

All Submittals shall be made to Engineer by Contractor, including those generated by subcontractors and suppliers. Contractor shall carefully review all subcontractor and supplier submittals before submitting to Engineer for review. Submittals received from sources other than Contractor's office shall be returned without action. If a submittal contains extraneous information, unmarked options or is incomplete, it will be returned to Contractor for correction and require re-submittal.

Submittals will be processed by Engineer within ten (10) working days after receipt from Contractor. Engineer will review submittals for general conformance with the Contract Documents and standards. Such review by Engineer shall not relieve Contractor or any subcontractor of any responsibility for full compliance with the Contract Documents. Unless specifically authorized to do so by Engineer, Contractor shall not procure, manufacture, or fabricate any part of the contract work until submittals related to said contract work have been favorably reviewed by Engineer.

Contractor shall deliver four copies of each submittal to Engineer. Each submittal shall contain, at a minimum, the following information:

1. Title page including the following information:

   Project Number and Name.
   Name of Contractor.
   Name of subcontractor (if applicable).
   Description of item.
   Item Number on Bid Schedule.
   Date of Submittal.
   Contractor's initials and date indicating approval of item for submittal to Engineer.

2. Index Sheet (For submittals containing information on multiple components. Each component shall be cross-identified with reference to a divider tab number).

3. Divider Tabs (For submittals containing information on multiple components. Tab numbers shall correspond to the index sheet for each component in the submittal).

4. The brochure, product data sheet or catalog cut (For each component in the submittal, separated by their respective divider tabs).

5. For shop drawings, Contractor shall submit four (4) clean, low background reproducible prints. Shop drawings larger than 11 x 17 in. shall be rolled, not folded.

6. Submittals that involve engineering computations or original design work shall show the name, the California State registration number, seal, and signature of the Professional Engineer certifying that such

computations or design work are correct and in conformance with applicable standards, codes and accepted engineering practices.

7. For product samples, Contractor shall submit two (2) representative samples, one of which may be retained for the duration of the project or indefinitely at the discretion of Engineer. Although a reasonable attempt will be made to maintain the samples in good condition, neither City nor its representative will be responsible for the condition of the samples if returned to Contractor.

8. For material samples, unless a specific quantity is called for in the contract documents, Contractor shall submit a representative sample of the material, which may be retained for the duration of the project or indefinitely at the discretion of Engineer.

9. Certificates of compliance shall be submitted by Contractor to Engineer for those materials and products for which no sample and test results are specified. Certificates of compliance shall include the following information:

Statement that the product complies with the respective contract specifications.

Producer's name and address, product trade name and catalog number (if applicable), place of product origin, quantity of product to be furnished, and related contract plans and specification section numbers.

A certified copy of test results pertaining to the product from a certified independent testing laboratory. At the option of Engineer certified test results shall be signed and sealed by a Professional Engineer licensed to practice in the state of California.

Contractor shall submit Material Safety Data Sheets (MSDS) for all materials used or stored on the site that possess a MSDS, including materials used by Contractor for maintenance of equipment.

5.23 CLAIMS AND DISPUTES:
See Section 11 of Agreement for claims and disputes.

5.24 PRESERVATION OF EXISTING MONUMENTS:
Preservation of existing monuments shall be Contractor's responsibility. Contractor shall notify Engineer of all monuments that may/will be disturbed by construction operations. Engineer will tie off said monuments and provide Contractor a notice to proceed.

Once Contractor is finished with its construction operations, Engineer will relocate the monuments. Contractor shall install a monument will with concrete collar at each location which shall conform to the provisions in Section 22-1 "Survey Monuments" and Drawing M-1 "Monument Detail," of the Standard Specifications and these special provisions.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved with protecting existing monuments as specified above, shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

5.25 BUSINESS LICENSE:
Contractor shall obtain a City of Turlock business license prior to issuance of the Notice to Proceed. The cost of the business license is fifty cents per thousand dollars in revenue. Business Licenses are obtained through the Finance Division at Turlock City Hall, 156 S. Broadway, Suite 114. Additional information can be found on the City's website at:

http://ci.Turlock.ca.us/doingbusinessinTurlock/businesslicenses/newbusinesslicense.asp

Full compensation for obtaining a business license as specified above shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

INTERNET BASED CONSTRUCTION MANAGEMENT SYSTEM:

General

The Engineer and Contractor shall utilize Virtual Project Manager (http://www.virtual-pm.com/), herein after called VPM, for submission of all data and documents (unless specified otherwise in this Section) throughout the duration of the Contract. VPM is an electronic project management system accessible through the Internet used to create, share, and review construction management documentation. VPM is provided by the Engineer at no cost to the Contractor. VPM will be made available to all Contractors' personnel, subcontractor personnel, suppliers, consultants, Engineer, and any of Engineer's representatives or agents. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, electronic notification of project activity, and overall management of contract documentation. VPM shall be the primary means of project information submission and management.

The Engineer will establish the Contractor's access to VPM by enabling access and assigning user profiles to Contractor personnel, including subcontractors and suppliers, as requested by Contractor. All authorized personnel shall have an individual user profile; no joint-use or shared user profiles will be allowed. Each user profile shall be assigned to a user group and have specific permission settings and privileges based on the user's need within VPM. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on VPM shall be the responsibility of the Contractor.

The Contractor shall use computer hardware and software that meets the requirements of the VPM system. As recommendations are modified by VPM, the Contractor will upgrade their system(s) to meet or exceed the recommendations. Upgrading of the Contractor's computer systems will not be justification for a cost or time modification to the Contract. The Contractor shall ensure its own connectivity to VPM through their internet service provider.

The Contractor shall be responsible for the validity of the information they place in VPM, for the training of their personnel to understand and utilize VPM, as well as the provision and accessibility of adequate resources to connect with VPM. Accepted users shall be knowledgeable in the use of computers, including Internet browsers, email programs, and the Portable Document Format (PDF) document type. The Contractor shall utilize the existing forms in VPM to the maximum extent possible. If a form does not exist in VPM the Contractor must include their own form or a form provided by the Engineer as an attachment to a submittal, RFI, or other document within VPM. Note that only the following file types are accepted as attachments to documents within VPM: PDF files, Microsoft Word (DOC) files, Microsoft Excel (XLS) files, picture files (JPG, TIFF, BMP, JPEG, etc.). PDF documents will be created through electronic conversion prior to uploading, such as through a "print to file" feature or "save as pdf" feature, rather than optically scanned whenever possible.

Contractor shall provide a list of key VPM personnel for the Engineer's acceptance. The list shall include the following information: first name, last name, address, title, office phone number, cell phone number, and email address. The Engineer is responsible for adding and removing users from the system and establishing read, write, and approval permission levels.

Company Documents

This area is reserved for general documentation not related to a specific project. Only the Engineer shall post content in this area. Examples of content found in this area are: the City of Turlock Standard Specifications and Drawings, the 2010 Caltrans Standard Specifications, and the 2010 Caltrans Standard Plans. All files are in PDF format.

Project Summary

The project summary tab provides an overall summary of the project. It includes the current weather, the working days remaining and a summary of work for the past week. The summary of work is generated from the City's project inspector and the daily logs. This tab is for information only and the Contractor shall not take any action here.

Task Manager

The project schedule the Contractor submits is converted into a format that is uploaded by the Engineer into the task manager tab. The Contractor is responsible for providing schedule updates to the Engineer whenever the work progress in a manner different than the approved schedule.

Change Order Manager

The change order manager tab shall be used to track project change orders. Any potential change orders shall be tracked as a Request for Information (RFI) in the RFI tab. Once the Engineer agrees that a RFI will result in a contract change order, a new contract change order shall be created by the Engineer in the change order manager tab. The Engineer will finalize the contract change order through this tab. Once the change order is finalized, the Engineer will present the contract change order at a City Council meeting. After City Council approval the Engineer will make payment on the contract change order.

Transmittals

The transmittal tab shall be used to communicate general project information amongst all parties as well as used by the Contractor in the submission of certified payroll reports. The Engineer will upload the project-specific information including: bid documents, conformed plans, conformed specifications and the Notice to Proceed to the transmittal tab.

The Contractor shall submit certified payroll reports on a weekly basis through the transmittal tab. Each week shall have a separate transmittal where all the certified payroll reports and statements of non-performance for each contractor shall be posted.

Submittals

All submittals shall be submitted through the submittal tab. The preferred document type is PDF.

Before making submittals, the Contractor shall ensure that products and materials will be available in the quantities and in the time required by the Contract and the approved schedule of activities. Each submittal shall be legible and clearly identify, by highlighting, arrows or other defined and permanent mark, the products and materials proposed for use.

All submittals shall be generated from the prime contractor and any submittals that are uploaded by subcontractors or suppliers will not be reviewed. Contractor shall carefully review all subcontractor and suppliers submittals before submitting it to the Engineer for review. If a submittal contains extraneous information, unmarked options or is otherwise incomplete, it will be rejected and the Contractor shall make corrections and upload the resubmittal. Any resubmittal shall be made to the same transmittal item in VPM.

Submittals shall be processed by the Engineer within ten working days after upload to VPM. The Engineer will review submittals for general conformance with the Contract Documents and standards. Such review by the Engineer shall not relieve the Contractor of any responsibility for full compliance with the Contract Documents. Unless specifically authorized to do so by the Engineer, the Contractor shall not procure, manufacture, or fabricate any part of the contract work until submittals related to said contract work have been approved by the Engineer.

Each submittal shall have a unique title that is comprised of the item followed by a comma and the section of the specifications that reference the item (e.g. Minor Concrete, Section 8.01). The submittal type shall either be project materials or project information. The submittal description shall be used to identify any pertinent information or list a description of the item being submitted.

Certificates of compliance shall be submitted through the submittal tab. The submittal type shall be “certificate of compliance”.

The Contractor shall submit progress invoices on the last working day of the month through the transmittal tab (select “progress invoice” for the type). The Engineer will review the submitted content and if found acceptable the Engineer will upload an official invoice for the Contractor to sign. The Contractor shall sign in blue ink and upload the signed invoice to the same transmittal where the Engineer will then process for payment.

RFIs

The RFI tab shall be used to request information from the Contractor to the Engineer. The Contractor shall create a RFI upon recognition of any event or question of fact arising from the contract work. The RFI type for this submittal shall be “Request for Information.” The Engineer will also utilize the RFI tab in a similar manner when there is a question for the Contractor; this RFI type shall be “Response Required.”

The Engineer will respond to a RFI submitted by the Contractor within five days. The Contractor shall proceed with the work unless otherwise ordered.

Daily Logs

The daily log tab is used by the City to document the activities of the work, any correspondence or direction given in the field, safety concerns and general comments about the project. The Contractor may view the contents of this tab for reference purposes. The information entered into the daily log tab is used to populate the project summary tab.

WSWD

The weekly statement of working days will be posted to the WSWD tab. VPM automatically generates the WSWD from the information entered into the daily log tab. The WSWD shows the working days and non-working days charged for the reporting week, any time adjustments, a work completion date with the remaining working days left in the contract and the controlling activities for the week.

The Contractor will be allowed 15 days from the last working day of the weekly statement to protest in writing the correctness of the statement. The Contractor shall submit a transmittal stating what is being protested and the reasons for protest. The Engineer will respond to the protest. The Contractor may protest the Engineer’s response by submitting a claim in accordance with Section 5.23 “Claims and Disputes” of the special provisions.

SECTION 6 - DESCRIPTION OF WORK

The work consists, in general, of rehabilitation of the existing GAC system at the Well 8 site, installation of a new well pump and VFD, installation of a new chlorine injection system, and installation of a nitrate monitoring system with a flush-to-waste option.

SECTION 7 - CONSTRUCTION DETAILS

Compensation for all work specified to be performed under this contract and shown on the drawings will be made under payment items listed herein and shown on the Bid Schedule. The contract prices for the said payment items shall be full compensation for all of the costs connected therewith including all labor, materials, tools, equipment, and incidentals furnished and doing all the work involved in completing the items of work including final cleanup as specified herein. It is the intent of this contract that the sum of all prices listed in the Bid Schedule shall represent the total lump sum cost of all work shown on the drawings and specified herein. Where items of work are not specifically defined in the schedule or included in the bid items, including mobilization and demobilization, these items shall be included in those bid items which are most closely related to the required work.

Separate payment will not be made for any item which is not specifically set forth in the bid items contained in the Proposal. Therefore, the Contractor's entire compensation for doing all work in accordance with the Contract Documents shall be included in the prices stated in the Proposal.

Bid Item 1 - Clean and Test GAC Vessels

This is a lump-sum bid for cleaning the interior of the two existing 12-foot-diameter GAC vessels on the project site, then conducting a high voltage spark test per ASTM D5162 to identify any holidays in the existing lining. This bid price shall include a second spark test following repair of any identified holidays in the vessel lining.

Cleaning shall be with clean, potable water only. No cleaning chemicals will be allowed. The carbon has been removed from the vessels, but some small volume of carbon grains may remain on the bottom of the vessel. The carbon has been tested and determined to be nonhazardous. This bid item shall include all costs associates with the cleaning and testing work. The wash water can be discharged to the on-site storm drain once any carbon grains or other debris have been filtered out.

Bid Item 2 - GAC Manifold Piping

This is a lump-sum bid for furnishing and installing all above ground water piping appurtenances necessary to re-connect the GAC vessels to the City distribution system, complete in place, where shown on the plans and as specified herein. This lump sum price shall also include removal of short sections of existing welded steel pipe and then installation of new motor-actuated valves and pipe spools where shown on the plans and as specified herein. The bid price shall include, but is not limited to, all costs for pipe spools, fittings, valves, supports, pressure testing, disinfection, and disinfection (water quality) testing per the plans and in accordance with the Project Specifications.

Bid Item 3 - GAC Vessel and Piping Recoating/Piping Relining

This item is a lump-sum bid for furnishing and installing the paint necessary to re-coat the exterior of the GAC vessels and all new and existing above ground piping in accordance with the Project Specifications. This bid item shall also include all work necessary to line the interior of the piping referenced above in accordance with the Project Specifications.

Bid Item 4 - GAC Vessel Lining Repair

This item is a unit-price bid for furnishing and installing the material necessary to reline the interior of the GAC vessels in accordance with the Project Specifications. This bid item shall also include all work necessary to conduct a 48-hour soak test (once the lining has cured sufficiently) in accordance with the Project Specifications. The soak test shall be completed before the second spark test is performed (as described in Bid Item 1). For bidding purposes, assume 50 square feet of new lining will need to be applied to covered holidays or other damage identified during testing.

Bid Item 5 - Chlorine Injection

This is a lump-sum bid for furnishing and installing a new chemical injection pump, injection and sample tubing and a sodium hypochlorite storage tank, where shown on the plans and as specified herein. The bid price shall include, but not be limited to, mounting a fiberglass shelf for the metering pump, installing a drain and sewer connection, penetrating the building wall as necessary to make the plumbing connections, and other modifications per the plan and in accordance with the Project Specifications.

Bid Item 6 - Reroof Pump Building

This item is a lump-sum bid for removing existing roofing material, repairing/replacing weather or damaged roof joists, beams, facia, etc., and then furnishing and installing a new roofing system per the plans and in accordance with the Project Specifications. This bid item shall include full compensation for proper disposal (inclusive of tipping fees) of existing roofing material. This bid item shall also include full compensation for acquiring the necessary City of Turlock building permit.

Bid Item 7 - New Pump and Motor with Variable-Frequency Drive

This item is a lump-sum bid for removing the existing well pump, repairing or replacing the well sounding tube, and then installing a new well pump and motor. This bid item also includes a new variable-frequency drive (VFD). The bid price shall include, but is not limited to, all costs for removing the pump and pump motor, installing a new pump and motor, installing a variable-frequency drive, installing a new sounding tube, disinfecting the pump, motor and sounding tube, and testing per the plans and in accordance with the Project Specifications.

Bid Item 8 - Chlorine and Nitrate Monitoring Equipment

This is a lump-sum bid for furnishing and installing the free chlorine analyzer and nitrate analyzer, complete in place, where shown on the plans and as specified herein. This lump-sum price shall include the sample connection, sample tubing, and sample drain installation as required for a complete, functioning monitoring system.

Bid Item 9 - Electrical Work and Instrumentation

This item is a lump-sum bid for furnishing and installing all electrical conduits, wires, lights, process instruments, wiring devices, testing, and startup, as shown on the plans and in accordance with the Project Specifications to provide a complete and operational system. Also included are the costs for furnishing and installing instrumentation including, but not limited to, all instrumentation hardware, material, labor, engineering, testing, and startup as shown on the plans and in accordance with the Project Specifications to provide a complete and operational system. The City will provide SCADA integration programming under separate contract.

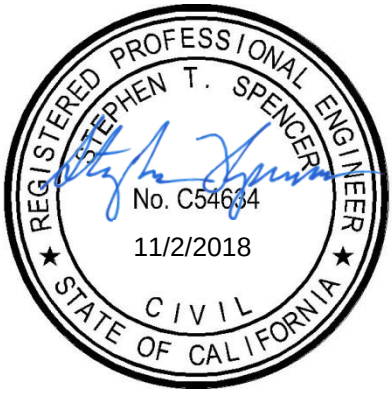
Bid Item 10 - Painting of Pump House

This item is a lump-sum bid for all costs for painting the existing pump house building, including all labor and equipment, in accordance with the Project Specifications.

Bid Item 11 - Mobilization/Demobilization

This lump-sum bid shall be full compensation for preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; for the establishment of all Contractor's facilities necessary for work on the project; for obtaining permits, bonds, and insurance; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various contract items on the project site. This item also includes demobilization, including removal of all equipment supplies, personnel, and incidentals from the project at the end of construction. Payment shall be per Division II Special Requirements and shall not exceed $40,000. Payment for mobilization shall be made with the first pay estimate and shall not exceed 80% of the bid amount. Payment for demobilization shall be made with the last pay estimate and shall not exceed 20% of the bid amount.

TECHNICAL SPECIFICATIONS



SECTION 019310 OPERATION AND MAINTENANCE MANUALS

A. General

Submit four copies of all manufacturer's operation and maintenance manuals and data pertinent to equipment supplied for the project. Prepare and organize the material in three-ring binders with divider tabs and labels. Include a table of contents. Include a CD of all catalog data in pdf format and all drawings in both pdf and CADD formats. All pdf files shall be formatted to allow word search.

B. Submittals

1. Submittals shall include:

   a. List of equipment furnished for project with name, address, and telephone number of each vendor.

   b. List of serial numbers of equipment furnished.

   c. A copy of shop drawings for mechanical, electrical, and instrument equipment in final form.

   d. Manufacturer's operation and maintenance instructions and parts lists.

   e. Tabulation of motor nameplate horsepower, nameplate current, field-measured current, overload relay setting, and catalog number for polyphase motors.

   f. List of fuses, lamps, seals, and other expendable equipment and devices. Specify size, type, and ordering description. List name, address, e-mail address, website address, fax number, and telephone number of vendor.

2. Provide manuals for the new municipal well pump and motor and project controls, including individual components and subsystems of complete assemblies. Line out nonapplicable text and illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

3. Each manual shall contain the following:

   a. Manufacturer's identification, including order number, model, and serial number.

   b. Blue line prints or reviewed shop drawings and diagrams of all systems.

   c. Certified equipment drawings or reviewed shop drawing data clearly marked for equipment furnished.

   d. Complete operating and maintenance instructions for each and every item of equipment, setting forth in detail and step-by-step the procedure for starting, stopping, operating, and maintaining the entire system as installed. Include a schedule of recommended maintenance intervals.

   e. Complete parts list of replaceable parts, their part numbers, and the name and address of their nearest vendor.

f. Any special emergency operating instruction and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

g. Copy of manufacturer's equipment guarantees and warranties.

4. Brochures shall be loose leaf with durable plastic or fiberboard covers. Each sheet shall be reinforced to prevent tearing from continued use, and each brochure shall have the following information clearly printed on its cover:

a. Project name, name of Owner, and address.

b. Name and address of Owner's Representative.

c. Name and addresses of contractors and subcontractors and department to contact.

d. Telephone number of contractors, including night and emergency numbers.

e. Major equipment vendors' names and telephone numbers.

5. Submit complete manuals at least four weeks before the date of the instructions required by the subsections on "Manufacturer's Services" in the various specification sections.

6. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start up equipment.

C. Equipment Data Sheets

Provide three sets of equipment data sheets, bound in three-ring binders, summarizing the equipment manufacturer's maintenance instructions and recommendations. A blank data sheet and a sample data sheet are attached.

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done		Frequency*
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

SAMPLE

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name: Influent Pump No. 1 Tag No.: P01-1	Size: 15 hp	
Serial No.: 123456ABC Vendor: ABC Pump Co.	Model: 140T Frame Serial No. 987654ZY Class F Insulation W/Space Heater	
Vendor Address: 1111 Pump Circle Newport Beach, CA 92663	Type: Mfr.: DEF Motors, Inc.	
Vendor Rep: XYZ Equipment, Inc.	Voltage: 460	Amps: 20
Phone: 714/752-0505	Phase: 3	rpm: 1,800
Maintenance Work to be Done		Frequency*
1. Operate all valves and check such things as a) bearing temperature, b) changes in running sound, c) suction and discharge gauge readings, d) pump discharge rate, and e) general condition of the drive equipment. 2. Check packing. 3. Checking pumping unit for any dust, dirt, or debris. (Continued on attached sheet)		D D W
OPERATING REQUIREMENTS AND REFERENCE		
For manufacturer's instructions regarding installation, operation, maintenance, and trouble shooting of this equipment, see Volume ____, Section _____.		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

SAMPLE

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done		Frequency*
4. Lubricate bearing frame and motor bearings (consult manufacturer's instructions for type of grease or oil). 5. Disassemble and change or repair the following: a) impeller, b) shafts, c) shaft sleeve, d) rotary seals, and e) sleeve bearings.		Q A
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

END OF SECTION

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SECTION 020120 PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

A. Description

1. Protect existing facilities in accordance with the Contract Special Requirements and this Section.

2. Protecting existing underground utilities.

a. Removing and plugging abandoned lines.

b. Compaction.

c. Alternative support methods.

d. Protecting thrust blocks.

B. References

1. American Society for Testing and Materials (ASTM):

a. C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

b. C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

C. Definitions

Class C Concrete: Refer to Section 030500.

D. Submittals

Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

1. Record drawings to include record survey coordinates and elevations.

2. Proposed locations for test pits.

E. Project/Site Conditions

Pipelines will be indicated on the drawings, but the right is reserved to the Owner, acting through the CM, to make such modifications in location as may be found desirable to avoid interference with existing utilities.

PART 2 - MATERIALS

A. Materials

1. Except as indicated, or as specifically authorized by the CM, where existing utilities to remain must be removed, reconstruct utilities with new material of the same size, type, and quality as that removed.

2. Vitrified Clay Sewer Pipe and Couplings: For pipe 8 inches or less in diameter, replace with plain-end pipe conforming to ASTM C700.

   a. Compression Coupling: ASTM C425, compression couplings. Use at least two lengths of pipe in crossing the trench section.

PART 3 - EXECUTION

A. Examination

Notify the City of Turlock and Underground Service Alert (USA; call 811) at least 72 hours before digging operations are scheduled to begin.

B. Preparation

Where utilities are parallel to or cross work, but do not conflict with work, notify the utility owner at least 48 hours in advance of construction at the crossing. Coordinate the construction schedule with the utility owner.

C. Procedures

1. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise indicated or specified.

2. Damage to Utilities to Remain: If existing utilities to remain are damaged, immediately notify utility owner, and repair to owner's satisfaction.

END OF SECTION

SECTION 024100 EQUIPMENT, PIPING, AND MATERIALS DEMOLITION

PART 1 - GENERAL

A. Description

This section describes demolition and removal of existing process, mechanical, and electrical equipment and piping.

PART 2 - MATERIALS

Refer to other sections of these specifications for material to be used as replacements for removal or abandoned equipment.

PART 3 - EXECUTION

A. General

Perform removal, replacement, abandonment, and demolition work specified and indicated in the drawings. Prepare remaining surfaces to receive new scheduled and specified materials and finishes or finish to match adjacent surfaces if no additional work is scheduled or indicated.

B. Removal and Replacement

1. Remove equipment indicated in the drawings.

2. Replace equipment indicated in the drawings.

C. Abandonment

Abandon in place equipment indicated in the drawings.

D. Relocation

None.

E. Salvage

Equipment salvaged from the premises is the property of the Owner. Carefully remove and handle the equipment. Unload the equipment and store it in the location designated by the Owner. Leave the property free of debris and material.

F. Existing Piping and Electrical Utilities

Well 8 is currently idle and will remain so until the project is complete. However, the treated water pipeline is under system pressure and the well site is still connected to the main power supply. Shut off or disconnect utilities affecting demolition work. Schedule shutdowns with the Owner; notify the Owner three working days in advance of any shutdown that is required to perform the work.

G. Plugging Abandoned Piping

Plug buried pipes 6 inches and larger to be abandoned. Plug pipes of all sizes to be abandoned under structures. Plug by placing a 3-foot-long concrete plug in the open ends.

H. Removal of Electrical Materials and Equipment

1. Unless otherwise noted, remove existing electrical materials and equipment from areas indicated for demolition. Disconnect circuits at their source. Remove materials no longer used, such as studs, straps, and conduits. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 3/4 inch below the final finished surface. Remove existing unused wires.

2. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface.

I. Patching

1. Patching shall mean the restoration of a surface or item to a condition as near as practicable to match the existing adjoining surfaces unless otherwise noted, detailed, or specified.

2. When patching involves painting, special coating, vinyl fabric, or other applied finish, refinish the entire surface plane (i.e., wall or ceiling), unless complete refinishing of the entire space is scheduled or specified.

3. Patching includes cleaning of soiled surfaces.

J. Demolition

1. Existing pipes and other items are to be removed, altered, salvaged, and disposed of as specified herein or indicated in the drawings. Remove and dispose of all portions of these items that interfere with project construction.

2. Perform the work in a manner that will not damage parts of the structure not intended to be removed or to be salvaged for the Owner. If, in the opinion of the Owner's Representative, the method of demolition used may endanger or damage parts of the structure or affect the satisfactory operation of the facilities, promptly change the method when so notified by the Owner's Representative.

3. Equipment, material, and piping, except as specified to be salvaged for the Owner, or removed by others, within the limits of the demolition, excavations, and backfills, will become the property of the Contractor and shall be removed from the project site. The salvage value of this equipment, materials, and piping shall be reflected in the contract price of the demolition work.

4. Do not reuse material salvaged from demolition work on this project, except as specifically shown.

END OF SECTION

SECTION 030500 GENERAL CONCRETE CONSTRUCTION

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of formwork, reinforcing steel, joints, concrete, and finishing and curing for general concrete construction.

B. Related Work Specified Elsewhere

Painting and Coating: 099000.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Prepare mix designs in accordance with ACI 318, Chapters 4 and 5, except as modified herein. Submit mix design in writing for review by the Owner at least 15 days before placing of any concrete.

3. Submit six copies of a report from a testing laboratory verifying that aggregate material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

PART 2 - MATERIALS

A. Nondomestic Cement and Additives

1. The use of nondomestic cement and additives in concrete may be permitted only after review of a written request to use such materials. The request to use nondomestic materials shall include a chemical analysis that indicates the material meets the project specifications. Certifications that state the nondomestic materials meet the project requirements will not be accepted.

2. Test reports for concrete materials shall be current to within three months of inclusion into the project and shall be identifiable to the materials supplied.

B. Formwork

1. Design forms according to ACI 347.

2. Class I Forms: Use steel forms, ply form, or smooth-surface plywood 3/4-inch minimum thickness for straight surfaces and 1/2-inch minimum thickness for curved surfaces.

3. Class II Forms: Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints.

4. Class II forms may be used for exterior concrete surfaces that are 1 foot or more below finished grade. Use Class I forms for all other surfaces.

5. Coat forms with form release agent.

C. Bond Breaker

Bond breaker shall be a nonstaining type which will provide a positive bond prevention, such as Williams Tilt-Up Compound, as manufactured by Williams Distributors, Inc., Seattle, Washington; Silcoseal 77, as manufactured by SCA Construction Supply Division, Superior Concrete Accessories, Franklin Park, Illinois; or equal.

D. Form Release Agent

1. Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agent shall be nonstaining and nontoxic after 30 days.

2. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

E. Reinforcing Steel

1. Reinforcement shall conform to ASTM A615 or A706, Grade 60.

2. Fabricate reinforcing in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute. Bend reinforcing steel cold.

3. Deliver reinforcing steel to the site bundled and with identifying tags.

F. Tie Wire

Tie wire shall be 16 gauge minimum, black, soft annealed.

G. Cement

1. Use domestic portland cement that conforms to ASTM C150, Type I or II.

2. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

3. Maximum tricalcium aluminate shall not exceed 8%. The maximum percent alkalies shall not exceed 0.6%.

H. Aggregates

Aggregates shall be natural rock, sand, or crushed natural rock and shall comply with ASTM C33, and shall contain less than 1% asbestos by weight or volume. Aggregates shall be free from any substances that will react with the cement alkalies, as determined by ASTM C1778.

I. Water and Ice

Use water and ice that is clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities that might reduce the strength, durability, or otherwise adversely affect the quality of the concrete. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

J. Concrete Admixtures

1. Class A concrete shall contain a water-reducing admixture conforming to ASTM C494, Type A. The amount of admixture added to the concrete shall be in accordance with the

manufacturer's recommendations. Admixture shall be Master Builders Pozzolith polymer-type normal setting, Plastocrete 161 or Plastiment, Sika Chemical Corporation, or equal.

2. Mineral Admixture: Class A concrete shall contain a mineral admixture, fly ash Class F, conforming to ASTM C618, not to exceed or replace more than 15% of the cement material required without the mineral admixture.

3. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

K. Grout

1. Nonshrink grout shall conform to ASTM C1107 and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 928, or equal. Components shall be inorganic.

2. Ordinary type grout (dry pack) shall consist of one part portland cement to two parts sand (100% passing a No. 8 sieve). Add sufficient water to form a damp formable consistency.

3. Expansive Grout: Premixed, cementitious mixture with a minimum 28-day strength of 3,500 psi. Provide air-entraining admixture as recommended by the manufacturer.

4. Epoxy Grout:

   a. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions.

   b. Use sand that is oven dry and meets the following gradation requirements for epoxy grout:

Sieve Size	No. 8	No. 50	No. 100
% Passing	100	30 ±15	5 ±5

L. Repair Mortar

1. Mortar used for repair of concrete voids shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted or the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

2. Materials for repair of major defects or cracks shall be in accordance with “Repair of Defects and Cracks” specified in Part 3.

M. Bonding Compound

1. Epoxy bonding compound shall be Sikadur 32 Hi-Mod, Sika Chemical Corporation, Lyndhurst, New Jersey; Concresive by BASF; Euco Epoxy 452 by Euclid Chemical Company; or equal.

2. Nonepoxy bonding compound shall be Weldcrete by Larsen Products Corp., Link by Sta-Dry Manufacturing Corp., Euco Weld by Euclid Chemical Co., or equivalent. The compound shall be rewettable for up to two weeks.

N. Concrete Mix Design

1. Conform to ASTM C94, except as modified by these specifications.

2. Maximum water-cement ratio for Class A concrete = 0.45 by weight.

3. Use classes of concrete as described in the following table:

Class	Type of Work	28-Day Compressive Strength (in psi)	Minimum Cement Content (in lbs per C.Y.)
A	Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, cradle, supports across pipe trenches, and reinforced pipe encasement.	4,000	564
B	Pavement	3,000	500
C	Floor grout and miscellaneous unreinforced concrete.	2,000	376

4. Measure slump in accordance with ASTM C143. Slump shall be as follows:

Slab on grade or heavy sections wider (in plan view) than 3 feet	3 inches maximum
Footings, walls, suspended slabs, beams, and columns	4 inches maximum
Pavement	2 inches maximum
Floor grout	4 inches maximum

Proportion and produce the concrete to have a maximum slump as shown. A tolerance of up to 1 inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

5. Aggregate size shall be 3/4 inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for slabs and sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1-1/2 inches maximum for all larger slabs and sections. Aggregate size for floor grout shall be maximum 3/8 inch.

6. Combined aggregate grading shall be as shown in the following table:

	Maximum Aggregate Size			
	1-1/2"	1"	3/4"	3/8"
Aggregate Grade per ASTM C33	467	57	67	8

7. Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

PART 3 - EXECUTION

A. Form Tolerances

1. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance (inch)
Sleeves and inserts	+1/4 -1/4
Projected ends of anchors	+1/4 -0.0
Anchor bolt setting	+1/4 -1/4
Finished concrete, all locations	+1/4 -1/4 in 10 feet
	Max ±1-inch in total length

The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts:	Centerline of sleeve or insert.
Projected ends of anchors:	Plane perpendicular to the end of the anchor as located in the drawings.
Anchor bolt setting:	Centerline of anchor bolt.
Finish concrete:	The concrete surface as defined in the drawings.

Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

B. Form Surface Preparation

1. Clean form surfaces to be in contact with concrete of foreign material prior to installation.

2. Coat form surfaces in contact with concrete with a release agent prior to form installation.

C. Form Reuse

Reuse only forms that provide a uniform surface texture on exposed concrete surfaces. Apply light sanding or other surface treatment between uses for uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side. Do not patch forms other than filling tie rod holes, except in the case of Class II forms. Do not use metal patching discs on Class I forms.

D. Removal of Forms

1. Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed:

Sides of footings and encasements	24 hours
Walls, vertical sides of beams, girders, columns, and similar members not supporting loads	48 hours
Slabs, beams, and girders	10 days (forms only)
Shoring for slabs, beams, and girders	Until concrete strength reaches specified 28-day strength
Wall bracing	Until top or roof slab concrete reaches specified 28-day strength

2. Do not remove forms from concrete that has been placed with outside air temperature below 50°F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

E. Formed Openings

Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

F. Embedded Items

Set anchor bolts and other embedded items accurately and hold securely in position until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concreting.

G. Beveled Edges (Chamfer)

Form 3/4-inch beveled edges on exposed concrete edges and corners, beam soffit corners, and where indicated in the drawings. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the drawings. The top edges of slabs, walkways, beams, and walls may be beveled with an edging trowel in lieu of using chamfer strips.

H. Time Between Pours

At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise indicated in the drawings.

I. Placing Reinforcement

1. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

2. Unless otherwise indicated, reinforcement indicated in the drawings is continuous through the structure to the farthest extent possible. Terminate bars and hooks 2 inches clear from faces of concrete.

3. Do not straighten or rebend reinforcing steel in the field.

4. Position reinforcing steel in accordance with the drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to provide the specified concrete coverage. Bars, in addition to those shown in the drawings, 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 his own expense.

5. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

6. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.

7. Roll wire mesh used for reinforcement flat before placing concrete. Support and tie wire mesh to prevent movement during concrete placement.

8. Position dowels for masonry walls to occur at reinforced block cells.

J. Site-Mixed Concrete

Conform to ACI 304R.

K. Ready-Mixed Concrete

Conform to ASTM C94.

L. Placing Concrete

Conform to ACI 304R.

M. Pumping Concrete

Conform to ACI 304.2R.

N. Weather Requirements

1. Conform to ACI 305R for placing during hot weather.

2. Conform to ACI 306R for placing during cold weather.

O. Grouting Machinery Foundations

Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown in the drawings. After the machinery has been set

in position and placed at the proper elevation by steel wedges, fill the space between the bottom of the machinery base and the original pour of concrete with a pourable nonshrink grout. Grout and grouting procedure shall be in accordance with API 686, Chapter 4, paragraphs 3.6 and 3.7, and Chapter 5.

P. Concrete Finishes

1. Complete concrete surfaces in accordance with the following schedule:

Finish Designation	Area Applied
F-1	Beams, columns, and exterior walls not exposed to view.
F-3	Beams, columns, and walls of structures or buildings exposed to view. Underside of formed floors or slabs.
E-1	Exposed edges. EXCEPTION: edges normally covered with earth.
E-2	Top of walls, beams, and similar unformed surfaces.

2. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2 inch, and fill tie holes.

   Finish F-3: In addition to Finish F-1, remove fins, fill depressions 1/4 inch or deeper, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.

   Finish E-1: Provide chamfer or beveled edges.

   Finish E-2: Strike smooth and float to an F-3 or F-4 finish.

Q. Curing Concrete

1. Conform to ACI 308R.

2. Water cure with burlap mats unless optional curing methods are permitted.

3. It is the responsibility of the Contractor to select the appropriate curing method in response to climatical and/or site conditions occurring at the time of concrete placement. Take appropriate measures as described in ACI 305R and 306R for protecting and curing concrete during hot and cold weather.

R. Repair of Defects and Cracks

1. Do not repair defects until concrete has been evaluated by the Owner's Representative.

2. Surface Defects:

   a. Repair surface defects that are smaller than 1 foot across in any direction and are less than 1/2 inch in depth.

   b. Repair by removing the honeycombed and other defective concrete down to sound concrete, cut or grind edges perpendicular to the surface and at least 3/8 inch deep, abrasive clean and thoroughly dampen the surface, work into the surface an epoxy

bonding agent, and fill the hole with one part cement to one part fine sand. Match the finish on the adjacent concrete, and cure as specified.

3. Severe Defects:

   a. Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure.

   b. Repair by removing the honeycombed and other defective concrete down to sound concrete, make edges of the repair area perpendicular to the surface, as required above, sandblast the sound concrete surface, coat the exposed surfaces with epoxy bonding compound, place nonshrink grout, match the finish on the adjacent concrete, and cure as specified.

4. Repair minor cracks in concrete structures that are wider than 1/10 inch by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and applying polyurethane joint sealant.

5. If the cracks are major or affect the hydraulic capacity or function of the element, the Owner's Representative may require the concrete to be repaired by epoxy injection.

6. Major Defects and Cracks: If the defects affect the structural integrity of the structure or if patching does not satisfactorily restore quality and appearance to the surface, the Owner's Representative may require the concrete to be removed and replaced, complete.

S. Concrete Tests

Not required.

END OF SECTION

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SECTION 050520 BOLTS, WASHERS, ANCHORS, AND EYEBOLTS

PART 1 - GENERAL

A. Description

This section describes materials and installation of anchor bolts, connecting bolts, washers, drilled anchors, epoxy anchors, screw anchors, eyebolts, and stainless steel fasteners.

B. Related Work Specified Elsewhere

1. General Piping Requirements: 400500.

2. Pipe Hangers and Supports: 400764.

C. Design Criteria

Structural Connections: AISC Specification for Structural Steel Buildings (June 1, 1989), except delete the second paragraph of Section A7.1, the last sentence of the first paragraph of Section M5, the last sentence of Section M5.2, and Chapter N in its entirety.

D. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and ICBO reports for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - MATERIALS

A. Anchor Bolts

1. Anchor bolts – nonchemical service. Steel anchor bolts shall conform to ASTM A307, Grade A, B, or C for non-hydraulic structures and Type 316 stainless steel for exposed or hydraulic structures.

2. Anchor bolts – chemical service. Anchor bolts for polyethylene chemical tanks and equipment inside the chemical room or for chemical service must comply with Section 434127, Part 2.F.

B. Connection Bolts

1. Steel connection bolts shall conform to ASTM A307. Connection type shall be N per the AISC handbook.

2. Provide self-locking nuts or lockwashers and plain nuts where shown in drawings.

3. Provide galvanized bolts where shown in drawings. Galvanizing of bolts, nuts, and washers shall be in accordance with ASTM F2329.

C. Stainless Steel Bolts

Stainless steel bolts shall be ASTM F593, Type 316. Nuts shall be ASTM F594, Type 316. Use ASTM F594 nuts with ASTM F593 bolts. Provide washer for each nut and bolthead. Washers shall be of the same material as the nuts.

D. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Husky™ Lube O'Seal, or equal.

E. Fasteners

Fasteners for polyethylene chemical tanks and equipment inside the chemical room or for chemical service must comply with Section 434127, Part 2.J.

F. Plain Unhardened Steel and Stainless Steel Washers

Washers shall comply with ASTM F844. Stainless steel washers shall be Type 316. Provide clipped washers where space limitations necessitate.

G. Drilled Anchors

1. Unless otherwise indicated in the drawings, drilled anchors shall be Type 316 stainless steel wedge anchors as manufactured by ITW Ramset/Redhead, Trubolt Kwik Bolt 3 by Hilti, or equal. Anchors shall have ICC-approved testing.

2. Where indicated in the drawings, drilled anchors shall be Type 316 stainless steel heavy-duty wedge anchors suitable for dynamic loading. Anchors shall be HSL heavy-duty wedge anchor by Hilti, Power-Bolt by Rawlplug Company, or equal. For metric anchors, use the size that is closest to, but no smaller than, the required English size.

H. Epoxy Anchors

1. Epoxy anchors in concrete shall be Type 316 stainless steel threaded rod adhesive anchors. Epoxy adhesive shall comply with ASTM C881, Type IV, Grade 3, Class B or C. Adhesive shall be Rawl Power-Fast, Hilti HIT RE 500, Simpson Epoxy-tie with SET epoxy, or equal. Epoxy anchor assemblies shall be ICC approved.

2. Epoxy anchors in grouted concrete masonry walls shall be Hilti HIT HY-150 adhesive and ASTM A36 F593 Type 316 stainless steel threaded rods as indicated in the drawings.

I. Screw Anchors

Screw anchors shall be Titan HD screw anchors by Simpson, HUS-H by Hilti, or equal.

J. Embedded Eyebolts

Eyebolts shall be of the welded-eye or forged type, Type 316 stainless steel.

K. Threaded Carbon Steel Lifting Eyes

Threaded carbon steel lifting eyes shall comply with ASTM A489, Type 1, Style B.

PART 3 - EXECUTION

A. Storage of Materials

Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

B. Galvanizing

Zinc coating for bolts, anchor bolts, and threaded parts shall be in accordance with ASTM F2329.

C. Installing Connection Bolts

1. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.

2. Install washers per AISC Specification for ASD.

3. Bolt holes in structural members shall be 1/16 inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.

4. Slotted holes, if required in the drawings, shall conform to AISC Specifications, Chapter J, Section J3, Table J3.1.

5. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts or washers shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.

6. Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened.

D. Installing Anchor Bolts

1. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, and blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.

2. For static items (storage tanks and heat exchangers), use preset anchor bolts or drilled anchors with ICC report data.

3. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.

4. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown in the drawings.

5. Minimum depth of embedment of epoxy anchors shall be as recommended by the manufacturer, no less than that shown in the drawings, or eight times the bolt diameter minimum.

6. Prepare holes for drilled and epoxy anchors in accordance with the anchor manufacturer's recommendations prior to installation.

E. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

SECTION 061110 WOOD FRAMING AND SHEATHING

PART 1 - GENERAL

A. Description

This section includes materials and installation of wood framing and sheathing including lumber, plywood, building paper, and rough hardware.

B. Related Work Specified Elsewhere

Prefabricated Wood Trusses: 061753.

C. Submittals

1. Provide submittals in accordance with Section 5.22 of the Special Provisions.

2. Provide supplier's statement of compliance with specified U.S. Federal or other standards.

D. Quality Assurance

Lumber grading rules and wood species shall conform with the Standard Grading and Dressing Rule 17 of the West Coast Lumber Inspection Bureau. Plywood grading shall conform with U.S. Product Standard PS-1.

PART 2 - MATERIALS

A. Lumber

1. Dimensions noted are nominal. Actual dimensions conform to industry standards established by the American Lumber Standards Committee and the rules writing agencies.

2. Provide visible grade stamp on lumber and plywood.

3. Moisture Content: 19% maximum at time of permanent closing in of building or structure, for lumber 2 inches or less nominal thickness. Grade stamp: S-Dry.

4. Surface four sides (S4S).

5. Structural light framing, 2 to 4 inches thick, 2 to 4 inches wide. Grade: Douglas fir No. 2.

6. Structural joists and planks, 2 to 4 inches thick, 6 inches and wider. Grade: Douglas fir No. 1.

7. Structural beams and stringers, posts and timbers 5 inches and thicker. Grade: Douglas fir No. 1.

B. Pressure Treatment

Use the following treatments and retention for the specified application:

Application	Treatment to be Used	Retention (lb/ft^3)
Aboveground wood	ACQ-B	0.25

C. Plywood

1. Exterior graded plywood where edge or surface is permanently exposed to weather or where ambient moisture content will exceed 18%.

2. Roof Sheathing:

   a. Grade: Structural I C-C exterior.

   b. Panel Identification Index: 30/12.

3. Wall Sheathing:

   a. Grade: Structural I C-C exterior.

   b. Panel Identification Index: 30/12.

D. Moisture Barrier

Asphalt-saturated felt, ASTM D226, 15-pound nonperforated; or building paper, Fed. Spec. UU-B-790A, Type I, Grade D.

E. Rough Hardware

1. Bolts: ASTM A307.

2. Nuts: Fed. Spec. FF-N-836E or ASTM A307.

3. Expansion Shields: ASME B18.2.1.

4. Lag Screws and Bolts: ASME B18.2.1.

5. Washers: ASTM F844.

6. Wood Screws: Fed. Spec. FF-S-111C.

7. Nails and Staples: ASTM F1667, Common.

8. Joist Hangers, Bar or Strap Anchors: Obtain from drawings.

9. Ply Clips: Extruded 6063-T6 aluminum alloy.

F. Connectors

1. Structural connectors designated in the drawings are by Simpson Company. Products by Silver Metal Products, Teco, or equal are acceptable. Substitutions to the designated connector must have at least the minimum ICC-recommended strength of the designated connector for the type of installation shown. Connectors in contact with pressure-treated lumber shall be G 185 (minimum) hot-dipped galvanized per ASTM A653.

2. Use hot-dipped galvanized fasteners with hot-dipped galvanized connectors.

G. Anchor Bolts in Contact With Pressure-Treated Lumber

1. Anchor bolts in contact with pressure-treated lumber shall be hot-dipped galvanized per ASTM A153.

2. Use hot-dipped galvanized nuts and hot-dipped galvanized washers with hot-dipped galvanized bolts.

PART 3 - EXECUTION

A. Standards

Conform to provisions of CBC unless otherwise indicated.

B. Condition of Surface

Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

C. Pressure-Treated Wood Products

Apply two brush coats of same preservative used in original treatment to sawed or cut surfaces of treated lumber.

D. Sills

1. Set level to within 1/16 inch in 6 feet. Unless otherwise indicated, secure with 1/2-inch by 8-inch minimum size anchor bolts embedded in the structure minimum of 6 inches, spaced maximum of 4 feet on center.

2. Join solid sill members with halved joints where not continuous and at corners minimum of 1-foot lapped joint. Lap built-up sill members minimum distance of 2 feet.

E. Nailing

Conform to Table 2304.9.1 of the CBC unless otherwise indicated.

F. Stud Framing

1. Provide single-bottom plate and double-top plates for load bearing partitions, 2 inches thick by width of studs. Provide single-bottom plates and single-top plates for nonload-bearing partitions, 2 inches thick by width of studs. Overlap double-top plate at corners and intersections. Face nail upper top plate to lower top plate.

2. Nail bottom plate to wood construction. Anchor bottom plate to concrete structure with anchor bolts.

3. Provide studs in continuous lengths without splices. Toenail studs to bottom plate and end nail to lower top plate. Provide triple studs at corners and partition intersection. Anchor studs abutting masonry or concrete with 1/2-inch anchor bolts, maximum spacing of 4 feet on center. Where partition are parallel with joists, locate joists directly below studs.

G. Headers

1. Use continuous headers, same width as studs, of depth required to span widest opening. Toenail headers to studs and opening framing.

2. Stagger joints in individual header members a minimum of three stud spaces, allowing no joints to occur over openings. Lap headers at intersections with bearing partitions or tie with metal straps.

H. Lintels

Unless otherwise indicated, use framing lumber of the same thickness as studs--number and depth as required to span opening. Bear ends of lintels minimum 1 1/2 inches in length for full width.

I. Plywood Roof Sheathing

1. Install panels with face grain perpendicular to supports, using panels with continuous end joints over two or more spans staggered between panels and locate over supports. Allow minimum space of 1/16 inch between end joints and 1/8 inch at edge joints for expansion and contraction of panels. Support edge joints by use of wood blocking, tongue-and-groove edges or panel clips.

2. Do not use unblocked panels less than 12 inches wide.

3. Minimum nailing is 6d common nails at 6 inches on center along panel edges and 12 inches on center at intermediate supports unless otherwise shown in drawings.

J. Plywood Wall Sheathing

1. Install panels with vertical joints occurring at studs.

2. Support panel edges with studs, blocking, or plates.

3. Minimum nailing is 6d at 6 inches on center at edges, 12 inches on center at intermediate supports.

K. Connectors

Install using fasteners indicated in the connector manufacturer's current catalog unless otherwise indicated in the drawings.

END OF SECTION

SECTION 072100 FIBERGLASS BUILDING INSULATION

PART 1 - GENERAL

A. Description

This section includes materials and installation of fiberglass building insulation in the form of batts or rolls.

B. Related Work Specified Elsewhere

Wood Framing and Sheathing: 061110.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and descriptive literature for the various types of insulation.

3. Indicate location of each type of insulation.

PART 2 - MATERIALS

A. Roof Insulation

Roof insulation shall be Kraft-faced fiberglass batts or rolls. Insulation shall be 9.5 inches thick, in width required for joist spacing, with an R-value of 30. Insulation shall be mounted under the roof sheathing.

PART 3 - EXECUTION

A. Installation

1. Fit insulation snugly between framing.

2. Maintain integrity of insulation over entire area to be insulated.

3. Insulate small areas between closely spaced framing members.

4. Carefully cut and fit insulation around pipes, conduits, and other obstructions.

5. Where pipes or conduit are located in stud spaces, place insulation between nonheated area and pipe, compressing insulation where necessary.

6. At wood joists/rafters, provide supplementary support using wire ties fastened at 12-inch centers to prevent sagging of insulation.

B. Roof Insulation

1. Staple facing flanges to sides of wood framing at 8-inch centers, or closer as necessary to hold flanges tightly to framing members.

2. Exercise care to ensure integral vapor barrier is continuous over entire surface.

3. Patch and seal punctures, tears, or voids in integral vapor barrier.

4. Install faced insulation with integral vapor barrier toward warm-in-winter side of assembly.

END OF SECTION

SECTION 074100 PREFORMED ROOFING/SIDING

PART 1 - GENERAL

A. Description

This section includes work necessary for preformed metal roofing (referred to as standing seam metal roof), preformed metal siding, preformed metal ceiling, accessories and appurtenances including flashing, reglets, caps, covers, valleys, starter cleats, rake sections, etc. as detailed.

B. Related Work Specified Elsewhere

1. Wood Framing and Sheathing: 061110.

2. Flashing and Sheet Metal: 076000.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Product Data:

a. Manufacturer's technical product data.

b. Installation instructions and recommendations.

3. Shop Drawings:

a. Roof plans at minimum 1/4" = 1'-0" scale.

b. Details at minimum 1½" = 1'-0" scale:

(1) Mechanical attachments

(2) Perimeter and joint flashing

(3) Expansion and contracting joints.

(4) Valleys

4. Samples:

a. Initial color selection: Provide manufacturers color charts (3 each) indicating full range of available colors, and finishes.

b. Final Color Selection: Submit 12-inch-long panel of color and finish selected.

D. Quality Control

1. Qualifications of Personnel: Use adequate numbers of skilled workmen who are thoroughly trained and have a minimum of 5 years experience installing metal roof systems and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

2. Codes and Reference Standards: In addition to complying with all pertinent codes and regulations, comply with any codes regarding preformed metal roofing and siding.

3. Guarantee: The metal roofing and siding materials shall have a full 20 year written guarantee, including labor, non-prorated, against defects in workmanship and materials and against failure of the coating system, including, but not limited to: chalking, fading, cracking, checking, peeling, or loss of adhesion. In addition, upon completion of the work of this section, and as a condition of its acceptance, deliver to the Owner a written guarantee signed by the contractor and the application contractor agreeing to maintain the roofing and flashings in a watertight condition for two years following application, and without additional cost to the Owner.

E. System Description

Performance Requirements:

1. 24-gauge panels UL 580 test rated Class 90 when installed over plywood sheathing, with roof fastener clips spaced 2'-0" on center maximum. The roof panel manufacturer must also subscribe to underwriters Laboratories' "Follow Up Service" assuring continuing product compliance with UL requirements. Shipment packaging of panels and attachment clips must bear UL Classification markings.

2. Air Infiltration: Panel to meet the following standard when tested in accordance with ASTM E-1680:

   a. With factory-applied continuous sealant - 0.05 cfm/Lin.ft of panel seam at 1.57 PSF positive pressure

3. Water Penetration: Panel to meet the following standard when tested in accordance with E1646-95.

   a. With factory-applied continuous sealant, no leakage at 6-24 psf.

F. Product Delivery, Storage and Handling

1. Delivery: Package roof panels for protection against transportation damage or deformation.

2. Storage: Stack materials on platforms or pallets above ground and cover with tarpaulins or other weathertight ventilating coverings. Do not store panels where they will accumulate water.

3. Handling: Exercise care in unloading, storing and erecting panels. Prevent bending, warping, twisting and surface damages.

G. Project Conditions

1. Field Measurements: Prior to fabrication of panels, take field measurements of substrates to receive panel system. Allow for trimming of panels where final dimension cannot be determined.

2. Proceed with roofing installation only after satisfactory conditions are met.

H. Warranty

1. Finish Warranty: Furnish manufacturer's written warranty covering failure of the factory applied exterior finish on metal panels for the warranty period. This warranty is in addition to

and not a limitation of other rights the Owner may have under the provisions of the Contract Documents.

2. Warranty Period: 20 years after date of Substantial Completion.

3. Contractor Warranty: Warrant installation of Preformed Metal Roofing System for a period of 2 years after Substantial Completion.

PART 2 – PRODUCTS

A. Manufacturers

1. Available Manufacturers: Subject to compliance with requirements, manufacturer's offering roof panel systems that may be incorporated into the work include, but are not limited to, the following:

a. AEP span, a division of ASC profiles, Sacramento, CA, (800) 726-272 or equivalent.

B. Products

1. Design Span Roof Panels or equivalent (standing seams at 17" o.c. roof and exterior siding).

2. HR-36 panels or equivalent (interior ceilings).

C. Materials

1. Panels:

a. Base Metal:

(1) Material: Steel conforming to ASTM A792, minimum yield 40,500 psi, thickness 24 gauge.

(2) Protective Coating: Zincalume conforming to ASTM A-792, AZ50.

b. Finish:

(1) Exterior Finish includes a baked-on 0.2 mil thick corrosion-resistant primer and a baked on 0.8 mil thick finish coat of Polyuniyllidine Fluoride (PVF_2) full 70% Kynar 500/Hylar 5000 for a total of 1.0 mil dry film thickness.

(2) Color: Custom color as selected by Owner’s Representative.

(3) Factory-Applied Seam Sealant: Cold-applied, non-skinning, ACRYL-R

(4) Configuration:

(a) Standing Seam: Roof and exterior wall panels shall consist of integral self-locking standing seams 1-3/4" high spaced 17" on center. Panels shall be factory correctively-leveled to minimize the occurrence of oil canning.

(b) Ceiling Panels: Ceiling panels shall have a profile with 1-1/2" deep ribs and 7-1/2" pitches. Panels shall be factory correctively –leveled to minimize the occurrence of oil canning.

2. Performance Requirements (Wall Panels)

a. 24-gauge panels rated as Class A, steel shall conform to ASTM A653 G-90 Galvanized or ASTM A792 Grade 40.

b. Air Infiltration: Panel shall meet the following standard when tested in accordance with ASTM E-1680.

(1) With factory-applied continuous sealant 0.08 cfm/lineal foot of panel seam at 1.57 psf positive pressure and 0.13 cfm/lineal foot of panel seam at 1.57 psf negative pressure.

c. Water Penetration: Panel shall meet the following standard when tested in accordance with ASTM E-1646-95.

(1) With factory-applied continuous sealant, no leakage at 6.24 psf.

3. Accessories:

a. Fasteners Clips: UL-90 rated clip: 18-gauge G-90 galvanized steel, 40 ksi yield strength, 3-1/2" long triple fastener type.

b. Fasteners:

(1) Fasteners for Wall Panels: #12-14SD 5/16" HWH with 1/2" diameter metal washer, per the panel manufacturer's recommendations as detailed.

(2) Other Fasteners: Self-drilling screw as recommended by manufacturers, length as required to penetrate bottom flute of metal decking 3/4 inch.

c. Sealant:

(1) Gunnable Grade Caulking: Single component polyurethane caulk.

(2) Tape Sealant: Butyl.

d. Bearing Plate: 22-gauge 4"x6" Zincalume-coated steel bearing plate.

4. Flashing:

a. Panel penetration flashing: Satisfy conditions of use.

b. Other Flashing: Material, gauge and finish to match panels. Dissimilar materials will not be allowed.

5. Fabrication:

a. Fabricate panels in continuous one-piece lengths and fabricate flashing and accessories in longest practical lengths.

b. Roofing panels shall be factory formed. Field formed panels are not acceptable.

6. Preformed end closures: Waterproofing, laminated, semi-rigid, crosslinked polyethylene foam shaped to tightly fit the panel configuration.

PART 3 – EXECUTION

A. Examination

1. Existing Conditions:

a. Verify substrate to receive panels is complete, in true plane, secure and otherwise properly prepared.

b. Do not start work until unacceptable conditions are corrected.

B. Preparation

1. Protection:

a. Treat, or isolate with protective material, any contacting surfaces of dissimilar materials to prevent electrolytic corrosion.

b. Workmen walking on Roofing Panels shall wear clean, soft-soled work shoes that will not pick up stones or other abrasive material which could cause damage and discoloration.

2. Surface Preparation: Clean and dry surfaces prior to applying sealant.

C. Installation

1. Panels:

a. Follow roof panel manufacturer's directions.

b. Install panel seams vertically.

c. Lap panels away from prevailing wind direction.

d. Do not stretch or compress panel side-lap interlocks.

e. Secure panels without warp or deflection.

f. Fully engage interlocking seams.

g. Remove strippable protective film, immediately preceding panel installation.

2. Allowable Erection Tolerance:

a. Maximum Alignment Variation: 1/4 inch in 40 feet.

3. Flashing:

a. Follow manufacturer's directions and Owner-approved shop drawings.

b. Overlap roof panels at least 6 inches.

c. Debur cut edge where necessary to saw-cut panels.

4. Cutting and Fitting:

a. Neat, square and true. Torch cutting is prohibited.

b. Openings 6 inches and larger in any direction: Shop fabricate and reinforce to maintain original load capacity.

c. Debur cut edge where necessary to saw-cut panels

D. Cleaning

1. Touch-Up:

a. Touch-up damage paint surfaces with air dry touch up paint provided by manufacturer. Follow directions carefully to minimize color irregularities. Use small brush application only. Do not spray touch-up paint.

b. Panels or flashings that have severe paint and/or substrate damage shall be replaced as directed by the Owner's Representative.

2. Cleaning and Repairing:

a. At completion of each day's work and at Work completion, sweep panels, flashing and gutters clean. Do not allow fasteners, cuttings, filings, or scraps to accumulate.

b. Remove debris from project site upon work completion or sooner, if directed.

END OF SECTION

SECTION 076000 FLASHING AND SHEET METAL

PART 1 - GENERAL

A. Description

This section includes materials and installation of flashing and sheet metal.

B. Related Work Specified Elsewhere

1. Preformed Metal Roofing/Siding: 074100.
2. Painting and Coating: 099000.

C. Design Criteria

Conform to the recommendations of SMACNA's Architectural Sheet Metal Manual.

D. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.
2. Provide details to show sizes, installation, anchorage, and interface with adjacent work of each metal configuration.
3. Indicate gauge, composition of sheet metal, and compliance with ASTM standards.

PART 2 - MATERIALS

A. Galvanized Steel

Comply with ASTM A653 with Coating Designation G-90. Provide minimum 24-gauge thickness unless noted otherwise.

B. Aluminum

Comply with ASTM B209, Alloy 3003, Temper H14, 0.032-inch minimum thickness.

C. Stainless Steel Sheet

Sheeting shall be Type 304 or 304L per ASTM A666, 24-gauge minimum thickness. Finish shall be No. 4 per ASTM A480.

D. Welding Rods and Wire for Stainless Steel Sheet

Electrodes shall be Type E308. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS A5.9.

E. Nails

Use flathead, wire, barbed, slating type, galvanized steel nails, conforming to ASTM F1667, with steel components and sheet. Use flathead, wire, barbed, slating type, aluminum nails, conforming to ASTM F1667 with aluminum components and sheet.

F. Screws

Use self-tapping sheet-metal type, conforming to ASME B18.6.3. Screw material shall be aluminum or stainless steel for use with aluminum flashing and galvanized steel for use with steel flashing.

G. Solder for Galvanized Steel

Comply with ASTM B32, Alloy Grade Sn50.

H. Sealant

Comply with ASTM C920, Type M, Grade P, Class 25 (minimum) for horizontal joints and Grade NS, Class 25 (minimum) for vertical joints.

I. Cleats

Provide with minimum width of 2 inches. Use the same material and thickness as the sheet metal.

J. Reglets

Use same material as sheet metal. Provide shop-formed corners and joint connectors.

K. Fabrication

Fabricate sheet metal with lines, breaks, and angles sharp and true with surfaces free from objectionable wave, warp, or buckle. Fold exposed edges of sheet metal back to form 1/2-inch-wide hem on side concealed from view. Finish work free from water leakage under all weather conditions.

PART 3 - EXECUTION

A. Preparation for Installation

Verify that substrates are smooth and clean to extent needed for sheet metalwork. Verify that reglets, cants, and blocking to receive sheet metal are installed and free of concrete and soil. Verify shapes and dimensions of surface to be covered.

B. Installation

1. Install work watertight, without waves, warps, buckles, fastening stresses, or distortion, allowing for expansion and contraction. Hem exposed edges. Angle bottom edges of exposed vertical surfaces to form drips. Clean and flux metals prior to soldering.

2. Common Lock Seams: 5/8-inch finished width. Four-ply loose lock.

3. Flat-Lock Seams: 3/4-inch finished width. Four-ply flat lock, malleted tight. Sweat full with solder.

4. Single-Corner Seams: 5/8-inch finished width. Three-ply loose lock. Corners lapped and soldered.

5. Lap Seams: 7/8-inch finished width.

6. Spaced Cleats: 2 feet on center. Secure to substrate with fasteners and cover heads with cleat tabs.

7. Continuous Cleats: Secure to substrate with fasteners spaced 1 foot on center.

C. Cleaning

As work progresses, neutralize excess flux with 5% to 10% washing soda solution and thoroughly rinse. Leave work clean and free of stains, scrap, and debris.

D. Painting and Coating

1. Coat aluminum in contact with ferrous metal, concrete, or masonry per Section 099000, System No. 54.

2. Exposed galvanized steel flashing shall have a coating per Section 099000, System No. 52. Color shall be selected by Owner's Representative.

3. Exposed aluminum flashing shall have an anodized finish. Color shall be selected by Owner's Representative.

END OF SECTION

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SECTION 099000 PAINTING AND COATING

PART 1 - GENERAL

A. Description

This section includes materials and application of painting and coating systems for the following surfaces:

1. Submerged metal.
2. Exposed metal.
3. Metal in contact with concrete.
4. Fusion-bonded epoxy coated steel.
5. Wood and masonry.
6. Exterior architectural coatings and finishes.
7. Interior architectural coatings and finishes.

It does not include coating steel water tanks and reservoirs.

B. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.
2. Submit manufacturer's data sheets showing the following information:
    a. Percent solids by volume.
    b. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
    c. Recommended surface preparation.
    d. Recommended thinners.
    e. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
    f. Application instructions including recommended equipment and temperature limitations.
    g. Curing requirements and instructions.
3. Submit color swatches.
4. Submit certificate identifying the type and gradation of abrasives used for surface preparation.

5. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

A. Painting and Coating Systems

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	Title	Generic Coating
Submerged Metal Coating Systems		
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
Exposed Metal Coating Systems		
15.	Exposed Metal, Atmospheric Weathering Environment	Acrylic
Coating Systems for Nonferrous Metals		
52.	Exposed Metal, Galvanized Steel, and Aluminum, and Copper	Synthetic resin
55.	Repair of Galvanized Surfaces	Cold galvanizing compound
Wood, Masonry, and Drywall Coating Systems		
60.	Wood, Masonry, and Drywall (Normal Exposure)	Acrylic latex
Coating System for Fusion Epoxy-Coated Steel Surfaces		
66.	Fusion Epoxy-Coated Steel, Color Coding	Epoxy
Exterior Architectural Coatings and Finishes		
72.	Semi-Gloss Finish on Exterior Metal	Acrylic latex
73.	Clear Sealer on Exterior Concrete and Masonry	Silane
Interior Architectural Coatings and Finishes		
81.	Semi-Gloss Finish on Concrete, Masonry, or Plaster	Vinyl acrylic
85.	Semi-Gloss Finish on Metal	Acrylic

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

B. Submerged Metal Coating Systems

1. System No. 7--Submerged Metal, Potable or Nonpotable Water:

Type: Epoxy.

Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or nonpotable water.

Surface Preparation: SSPC SP-10.

Coating System: Apply the manufacturer's recommended number of coats to attain the specified minimum coating thickness. Products: Devoe Bar-Rust 233H, Tnemec N140 or 100, Sherwin-Williams Tank Clad HS B62-80, PPG AQUAPON® LT NSF Low Temperature Epoxy Coatings 95-172, Carboline Carboguard 891, Ameron 395, International Interline 785HS, Carboline Plasite 9133, Keysite 740, Scotchkote 306, or equal; 24 mils total. Color of topcoat: white. Each coat shall be different color than the one preceding it. Coating to be certified to NSF/ANSI Standard 61 for direct potable water contact.

C. Exposed Metal Coating Systems

1. System No. 15--Exposed Metal, Atmospheric Weathering and Water Condensation Environment:

Type: One component acrylic enamel having a minimum volume solids content of 35% with an acrylic primer.

Service Conditions: For use on interior and exterior metal and piping subject to sunlight, weathering, and water condensation.

Surface Preparation: SSPC SP-6.

Prime Coat: Sherwin-Williams Pro-Cryl Universal Primer, ICI Devoe Devflex 4020DTM water-borne primer, Carboline 3358, Tnemec Series 18, or equal applied to a minimum dry-film thickness of 3 mils.

Finish Coats: Two or more coats of Sherwin-Williams Sher-Cryl B66–300, ICI Devoe Devflex 659, Carboline 3359 or 3359DTM, Tnemec Series 28 or 29, or equal. Apply sufficient coats to provide a total minimum dry-film thickness of 8 mils. Thickness of any individual coat shall not exceed 4 mils.

D. Coating Systems for Nonferrous Metals

1. System No. 52--Exposed Metal, Galvanized Steel, Aluminum, and Copper:

Type: Synthetic resin or epoxy primer.

Service Conditions: Coat galvanized steel and aluminum and copper surfaces with this system before applying topcoat.

Surface Preparation of Galvanized Steel: Surfaces shall be flat with no protrusions. Remove high spots and tears in the galvanizing with hand and power grinders. Comply with ASTM D6386, paragraph 5.2.1. Do not remove the galvanized coating below the specified thickness. Solvent clean galvanized surfaces per ASTM D6386, paragraph 5.3.2. Then sweep blast per ASTM D6386, paragraph 5.4.1. Use one of the abrasive materials that is described in ASTM D6386, paragraph 5.4.1. Surface preparation for weathered and partially weathered galvanized steel shall be in accordance with ASTM D6386, paragraphs 6 and 7. Apply prime coating within one hour of the surface preparation.

Surface Preparation of Aluminum: Solvent clean or steam clean aluminum surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast and follow with a chemical conversion coating per MIL-DTL-5541, Class 1A.

Surface Preparation of Copper: Solvent clean or steam clean copper surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Prime Coat: Tnemec N69-1211, Ameron 385, ICI Devoe Devran 224HS, Carboline 890, Sherwin-Williams Macropoxy 646 B58-600 series, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal. Apply to a minimum thickness of 4 mils.

2. System No. 55--Repair of Galvanized Steel Surfaces:

Type: Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90%.

Service Conditions: Repair of damaged galvanized coatings on steel surfaces.

Surface Preparation: Clean damaged surfaces per SSPC SP-1 and SP-11.

Coating System: Apply Z.R.C. Galvanizing Compound, RAMCO Specialty Products "Zinckit," NuWave "Galv-Match-Plus," Devcon "Cold Galvanizing," Clearco "Cold Galvanizing Spray," or equal to a minimum dry-film thickness of 3 mils. Apply per ASTM A780, Annex A2.

E. Wood, Masonry, and Drywall Coating System

1. System No. 60--Plaster, Wood, Masonry, and Drywall:

a. Type: Acrylic latex coating having a minimum volume solids of 40%.

b. Service Conditions: For use coating weather-exposed or enclosed concrete masonry, drywall, wood, and plaster.

c. Surface Preparation: Surfaces shall be dry, clean, and free of contaminants.

(1) Masonry: Allow to cure 28 days, level protrusions, and remove mortar splatter. Then prepare surfaces in accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated."

(2) Drywall: Sand joint compound smooth and feather edges.

(3) Wood: Sand exposed surfaces.

d. Prime Coat: Self-priming or:

(1) Masonry: ICI Devoe Bloxfill 4000, Carboline Sanitile 100, Tnemec Series 130, Sherwin-Williams Heavy Duty Block Filler B42W46, PPG PITT-GLAZE® Int/Ext Latex Block Filler 16-90, or equal.

(2) Drywall: ICI Dulux 3210, Tnemec 51-792, Carboline Sanitile 120, Sherwin-Williams Prep-Rite B28W400, PPG SPEEDHIDE® Interior Latex Primer Sealer 6-2, or equal.

(3) Concrete: ICI Dulux 2000, Tnemec Series 130, Carboline Sanitile 100, Sherwin-Williams Loxon A24W300, PPG PERMA-CRETE® Interior/Exterior Alkali-Resistant Primer 4-603, or equal.

(4) Wood: One coat of Tnemec Series 6, Tneme-cryl; one coat of Carboline 3359MC; one coat of ICI Dulux Professional; one coat of Sherwin-Williams Metalatex B42 series; one coat of PPG PITT-TECH® Int/Ext Satin DTM

Industrial Enamel 90-474 series; or equal. Color: white. Apply to a minimum dry-film thickness of 2 mils.

e. Finish Coat: Two coats of Tnemec Series 6, Tneme-cryl, 2 mils each; two coats of Carboline 3359, 2 mils each; two coats of ICI Dulux Professional, 2 mils each; two coats of Sherwin-Williams Metalatex B42 series, 2 mils each; two coats of PPG PITT-TECH® Int/Ext Satin DTM Industrial Enamel 90-474 series, 2 to 3 mils each; or equal.

F. Coating Systems for Fusion Epoxy-Coated Steel Surfaces

1. System No. 66--Fusion Epoxy-Coated Steel, Color Coding:

Type: Epoxy having a minimum volume solids content of 60%.

Application: Color coding of pipe or steel surfaces already coated with fusion bonded epoxy.

Surface Preparation: SSPC SP-1. Then roughen the epoxy surface with power tool cleaning per SP-3 or a light sandblast per SP-7.

Prime Coat: None.

Finish Coat: One coat of Carboline 890, Tnemec 104, International Interguard 760HS, Ameron 385, ICI Devoe Devran 224HS, Sherwin-Williams Macropoxy 646 B58-600 series, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal. Apply to a minimum dry-film thickness of 5 mils.

G. Exterior Architectural Coatings and Finishes

1. System No. 72--Semi-Gloss Finish on Exterior Metal:

Type: Acrylic semi-gloss enamel with minimum volume solids of 35% with an acrylic or water-based inorganic zinc silicate metal primer.

Surface Preparation: SSPC SP-6 or SP-11; acid-etch galvanized surfaces.

Prime Coat: Dunn-Edwards GE-123 Galva-Etch (ferrous) or 43-7 Galv-Alum (nonferrous), Ameron Dimetcoat 21-5 (with 856 additive), International Intercryl 510WB, ICI Devoe 4020, Tnemec Series 18, Sherwin-Williams Kem Bond HS B50NZ (ferrous) and Galvite HS B50WZ30 (nonferrous), or equal; 3 mils.

Finish Coat: Two coats, 1.5 mils dry each, of Dunn-Edwards W-901, Ameron 220, International Intercryl 530WB, ICI Devoe 2406, Tnemec Series 29, Sherwin-Williams Metalatex B42-100, or equal.

2. System No. 73--Clear Sealer on Exterior Concrete and Masonry:

Type: Silane with minimum solids of 22%.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

Prime Coat: One coat Monochem Silane 20 Penetrating Sealer or Hydrozo Enviroseal 7, two coats Okon Block Plugger, one coat Rainstopper 140, two coats Carbocrete Sealer WB. Apply at 80 square feet per gallon.

Finish Coat: Two coats Hydrozo Enviroseal 7, one coat Okon W-2, one coat Rainstopper 140, one coat Carbocrete Sealer WB. Apply at 80 square feet per gallon.

H. Interior Architectural Coatings and Finishes

1. System No. 81--Semi-Gloss Finish on Concrete, Masonry, or Plaster:

Type: Acrylic semi-gloss enamel with minimum volume solids of 30% with an acrylic primer-sealer.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

Prime Coat: Dunn-Edwards W-715 Ultra-Grip, Frazee 168 Prime Plus, International Intercryl 510WB, ICI Dulux 3210, Carboline 3358, Tnemec Series 6, or equal; 2 mils.

Finish Coat: Two coats, 1.5 mils dry each, of Dunn-Edwards W-450V, Frazee 124 Mirro Glide SG, International Intercryl 530WB, ICI Dulux 1407, Carboline 3359, Tnemec Series 29, or equal.

2. System No. 85--Semi-Gloss Finish on Metal:

Type: Acrylic semi-gloss enamel with minimum volume solids of 55% with an alkyd or acrylic metal primer.

Surface Preparation: SSPC SP-6 or SP-11.

Prime Coat: Dunn-Edwards 43-5 (ferrous) or 43-7 (nonferrous) Galv-Alum, Frazee 561 or 664 (ferrous) or 661F774 or 561 (galvanized steel or aluminum), ICI Devoe 4020, Tnemec Series V10, Sherwin-Williams Kem Bond HS B50 NZ series (ferrous) or Pro-Cryl B66-310 series (nonferrous), Carboline Carbocoat 150 Universal Primer, or equal; 3 mils.

Finish Coat: Two coats, 1.5 mils dry each, Dunn-Edwards W-450V, Frazee 143 Mirro Glide Gloss, ICI Dulux 1407, Tnemec Series 29, Sherwin-Williams Pro Mar 200 S/G B31W200, Carboline 3359, or equal.

I. Abrasives for Surface Preparation

1. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:

a. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.

b. 20 to 40 mesh garnet.

c. Crushed iron slag, 100% retained on No. 80 mesh.

d. SAE Grade G-40 or G-50 iron or steel grit.

2. Abrasives used for preparation of stainless steel surfaces shall be 20 to 40 mesh silicon carbide or aluminum oxide.

3. Abrasives used for preparation of copper and aluminum surfaces shall be one of the following:

a. Crushed slag, 80 to 100 mesh.

b. Very fine silica sand, 80 to 100 mesh.

4. Abrasives used for preparation of concrete and masonry surfaces shall be 16 to 30 or 16 to 40 mesh silica sand.

5. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

J. Organic Zinc Primer for Field Touch-Up and Shop Coating

Where shop-applied inorganic zinc primers cannot be used because of volatile organic compound (VOC) regulations, the organic zinc primer described in System No. 18 may be substituted for the specified inorganic zinc primers.

PART 3 - EXECUTION

A. Weather Conditions

1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.

2. Do not apply paint when the relative humidity is above 85%.

3. Do not paint when temperature of metal to be painted is above 120°F.

4. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.

5. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

B. Surface Preparation Procedures

1. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.

2. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

3. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.

4. Do not abrasive blast PVC, or equipment. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.

5. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.

6. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

7. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC (Society for Protective Coatings), surface preparation specifications listed above.

8. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.

9. Brush-off blasting of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.

10. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner’s Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner’s Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner’s Representative.

11. Do not apply any part of a coating system before the Owner’s Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner’s Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

C. Preparation of Concrete and Masonry Surfaces To Be Coated

1. Surface preparation of concrete and masonry surfaces shall be in accordance with SSPC SP-13 and the following.

2. Do not apply coating until concrete has cured at least 30 days. Do not use curing compound on surfaces that are to be coated.

3. Concrete and masonry surfaces on which coatings are to be applied shall be of even color, gray or gray-white. The surface shall have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff-bristle fiber brush shall produce no dusting or dislodging of cement or sand. Sprinkling water on the surface shall produce no water beads or standing droplets. Concrete and masonry shall be free of laitance and slick surfaces.

4. Detergent clean the concrete or masonry surface with trisodium phosphate per ASTM D4258. Then sandblast surfaces (brush-off blast). Floor slabs may be acid etched per ASTM D4260 in lieu of sandblasting. After sandblasting, wash surfaces with water to remove dust and salts, per ASTM D4258 or D4261. The grain of the concrete surface to touch shall not be rougher than that of No. 10 mesh sand.

5. Prior to coating concrete, plaster, and masonry with System No. 36, determine the presence of capillary moisture per ASTM D4263, except as modified below. Tape a 4-foot by 4-foot sheet of polyethylene plastic to the concrete surface to be coated. Allow the plastic sheet to remain in place at least 24 hours. After the specified time has elapsed, remove the plastic sheet and visually examine both the underside of the plastic sheet and the concrete surface beneath it. There shall be no indication of moisture on either surface. If moisture is indicated, allow additional curing time for the concrete and then retest. Provide one test sheet for every 300 square feet of concrete surface to be coated. For walls, provide one test sheet for each 10 feet (or fraction thereof) of vertical rise in all elevations starting within 12 inches of the floor or base slab.

6. Acceptance criteria for concrete surfaces (except for those coated with System No. 73 shall be in accordance with SSPC SP-13, Table 1, “Severe Service.”

7. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable, not rising.

D. Procedures for Items Having Shop-Applied Prime Coats

1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.

2. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.

3. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

E. Field Touch-Up of Shop-Applied Prime Coats

1. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

2. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Rinse scrubbed surfaces with clean water.

3. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.

4. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.

5. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.

6. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.

7. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer to cover scratches or abraded areas.

8. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

F. Painting Systems

1. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

2. Deliver paints to the jobsite in the original, unopened containers.

G. Paint Storage and Mixing

1. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.

2. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small

quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

H. Procedures for the Application of Coatings

1. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

2. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

3. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.

4. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.

5. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.

6. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

7. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

8. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer’s recommendation.

9. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.

10. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner’s Representative.

11. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

I. Surfaces Not To Be Coated

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

1. Concrete walkways.

2. Mortar-coated pipe and fittings.

3. Stainless steel.

4. Metal letters.

5. Glass.

6. Roofings.

7. Fencing.

8. Copper tubing, red brass piping, and PVC piping except where such piping occurs in rooms where the walls are painted, or required for color coding.

9. Electrical fixtures except for factory coatings.

10. Nameplates.

11. Grease fittings.

12. Brass and copper, submerged.

13. Buried pipe, unless specifically required in the piping specifications.

14. Fiberglass items, unless specifically required in the FRP specifications.

15. Aluminum handrail, stairs, and grating.

J. Protection of Surfaces Not To Be Painted

Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

K. Surfaces To Be Coated

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as “corrosive environment,” “buried metal,” or “submerged metal.” Coat surfaces with the specific coating systems as described below:

1. Coat mechanical equipment, such as pumps, as described in the various mechanical equipment specifications. Color of finish coat shall match the color of the connecting piping.

2. Coat aboveground and exposed piping or piping in vaults and structures as described in the various piping specifications. Color of finish coat shall be determined by Owner.

3. Coat valves as described in the various valve specifications. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.

4. Coat masonry surfaces where shown in the drawings. Apply System No. 73 on exposed exterior masonry, System No. 81 on exposed interior masonry.

5. Coat architectural wood surfaces where shown on the drawings. Apply System No. 60 on exterior and interior surfaces.

6. Coat aluminum surfaces in contact with concrete per System No. 54.

7. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes as specified in the particular specifications for the above items.

8. Coat flashing and sheet metal System No 72. Color of finish coat shall match the color of the adjacent surface.

9. Coat hollow metal doors and frames System No. 72. Color of finish coat shall be selected by Owner.

L. Dry-Film Thickness Testing

1. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.

2. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Rasor or K-D Bird Dog.

3. Measure coating thickness specified for concrete or masonry surfaces in accordance with ASTM D4138. Test the finish coat of concrete and masonry surfaces in accordance with NACE RP-0188 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.

4. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

5. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.

6. Perform tests in the presence of the Owner's Representative.

M. Repair of Improperly Coated Surfaces

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

N. Cleaning

1. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.

2. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.

3. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

SECTION 133448 PRECAST CONCRETE BUILDING

PART 1 - GENERAL

A. Description

This section includes materials and installation of a precast concrete building for electrical and pumping equipment.

B. Related Work Specified Elsewhere

General Electrical Requirements: 260500.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Building drawings and calculations submitted by the manufacturer shall be stamped by a civil or structural engineer registered in the state of California. Show interior finish, exterior finish, door locations and size, ventilation system design and equipment, electrical system, lighting, and locations of conduits in walls and floor slab.

PART 2 - MATERIALS

A. Manufacturer

The building shall be manufactured by Easi-Set as manufactured by Rockway Precast, Las Vegas, Nevada (888) 762-5923; CSI Shelter Technologies, Londonderry, New Hampshire (800) 342-3374; J. E. Hill Precast, Leesburg, Florida (352) 787-5897; or equal.

B. Building Design

1. The buildings shall be precast and prewired units, with exterior dimensions as shown on the plans. Design the buildings to meet requirements of 2012 IBC:

   a. Roof Live Load: 20 psf.

2. Seismic Design Parameters--Conform to IBC, Section 1613 and ASCE 7-10:

   a. Occupancy Category: III.

   b. Importance Factor: 1.50.

   c. Seismic Design Category: D

   d. R: 3.0.

   e. S_s: 0.652.

   f. S_1: 0.273.

   g. S_{DS}: 0.556.

h. S_{D1}: 0.337.

i. Site Class D.

3. Wind Design Parameter--Conform to IBC/ASCE 7-10:

a. Wind Velocity, mph: 115.

b. Exposure Category: C.

c. K_D = 0.85.

d. K_{zt} = 1.0.

e. K_z = 0.85.

f. q_Z = 24.5 psf.

g. D = 8'-0".

h. C_f = 0.53 (Fig. 29.5-1).

i. G = 0.85.

j. Allowable Soil Bearing Pressure: 1,000 psf.

4. Design the buildings so that the walls and roof are monolithic and modular at manufacture, with the floor connected to the walls by a second pour. Design to be handled and off-loaded with lifting lugs in the roof.

C. Concrete

1. Concrete strength shall be minimum 5,000 psi at 28 days. Reinforcement shall be per ASTM A615, Grade 60 and welded wire mesh per ASTM A185.

2. Interior finish shall be smooth steel form finish on all interior surfaces.

3. Exterior finish shall be split-face block.

D. Door and Frames

Provide the buildings with an 18-gauge honeycomb core galvanized steel door, 3 feet wide by 7 feet high. Provide the door with a 14-gauge doorframe with 3/4-inch stepped steel threshold and three 4-1/2-inch hinges with vandal-resistant, nonremovable hinge pins. Above the door, provide a rain drip cap. Lockset shall be Schlage extra heavy duty. Door swing shall be as indicated in the drawings.

E. Mechanical System Requirements

Provide the building with the following factory-installed features:

1. Exhaust fan system with exterior wall switch adjacent to entry door. Size ventilation system to provide 12 air changes per hour, minimum.

2. Louvers and dampers. Face velocity shall not exceed 300 fpm.

3. Single wall-mounted air conditioner shall be sized to maintain internal building temperature at no more than 80 degrees Fahrenheit. Air conditioner shall have an integral thermostat and control panel.

4. Building mechanical equipment shall require no more than 120 volt, single phase power.

F. Electrical System Requirements

1. Provide transformer and panelboard per electrical drawings and specifications.

2. See electrical plan sheets and specifications for type and locations of light fixtures and receptacles.

3. Provide ports for electrical and instrumentation conduits. The penetrations shall be through the wall of the structure. Coordinate the size and locations of penetrations with the supplier.

G. Drainage Openings

Provide four 8-inch by 4-inch rectangular openings in the bottom of the building walls as shown on the plans. Openings shall be covered with 1/8-inch stainless-steel screen mounted to the inside of the wall.

PART 3 - EXECUTION

A. Utilities

Perform any field modifications, such as routing conduits and pipe through the floor slab. Seal penetrations water tight.

B. Foundation Installation

Contractor shall coordinate with Supplier regarding requirements for precast foundation subgrade preparation.

C. Sealing and Weatherproofing

After assembly of the building modules, seal and waterproof each joint. Seal roof joints with a four-part roofing system.

END OF SECTION

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SECTION 260500 GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of the electrical system.

B. Related Work Specified Elsewhere

1. Operation and Maintenance Manuals: 019310.

2. Equipment, Piping, and Materials Removals and Demolition: 024100.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. In submitted catalog cuts, cross out items shown that are not pertinent to this project. Where catalog cuts list manufacturer's standard options, cross out those options not intended to be provided and clearly highlight those options that are to be provided.

3. Submit electrical service changes work procedure.

D. Regulatory Agencies and Standards

Electrical work shall comply with the California Electrical Code and local city codes, whichever are more stringent.

E. Quality Control

Materials, appliances, equipment, and devices shall conform to the applicable UL standards. The label of, or listing by, UL is required for all electrical equipment.

F. Electrical Service Changes

1. These specifications and drawings delineate the remodeling of an existing structure and/or the addition to an existing structure. While the existing structure is occupied, keep the present services intact until the new construction, facilities, or equipment is installed.

2. Prior to making revisions to the existing service, make certain that every item is thoroughly prepared. Do the actual work at an off-peak time, or overtime, as arranged with the Owner or as hereinafter specified. Once the work is started, vigorously prosecute it to completion to keep downtime to a minimum. Be prepared to temporarily serve the existing service or discontinue the necessary revisions in the event of an emergency or other condition which makes it impossible to finish the scheduled work on time.

3. Prepare a work procedure for work-interrupting service to the Owner's equipment. Include a step-by-step procedure that will be followed in the performance of this work and the time involved in each step. Submit this procedure to the Owner's Representative for review two weeks in advance of the performance of the work.

G. Power for Construction

Provide for or purchase power for construction in accordance with Section 015100.

H. Operation and Maintenance Manuals

Submit operation and maintenance manuals in accordance with Section 019310.

I. Locations

1. General: Use equipment, materials, and wiring methods suitable for the types of locations in which they are located as defined below.

2. Definitions of Types of Locations:

   a. Dry Locations: Indoor areas which do not fall within the definitions below for wet or corrosive locations and which are not otherwise designated in the drawings.

   b. Wet Locations: Locations exposed to the weather, whether under a roof or not, unless otherwise designated in the drawings.

   c. Corrosive Locations: Areas identified in drawings.

PART 2 - MATERIALS

A. General

1. Similar materials and equipment shall be the product of a single manufacturer.

2. Provide only products which are new, undamaged, and in the original cartons or containers.

3. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current design.

4. Materials and equipment shall be suitable for storage, installation, and operation at an ambient temperature of 0°C to 40°C except where more stringent conditions are stated in individual equipment specifications.

5. Electrical equipment and panels shall be factory finished with manufacturer's standard primer and enamel topcoats, unless stated otherwise in the individual equipment specifications. Provide 1 pint of the equipment manufacturer's touchup paint per 500 square feet of painted surface for repair of damaged enamel topcoats.

PART 3 - EXECUTION

A. Installation

1. The drawings indicate connections for typical equipment only. If the equipment furnished is different from what is shown, provide the modifications necessary for a safe and properly operating installation in accordance with the equipment manufacturer's recommendations.

2. The drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Field determine exact location based on physical size and arrangement of equipment, finished elevations, and obstructions.

3. Work or equipment not indicated or specified which is necessary for the complete and proper operation of the electrical systems shall be accomplished without additional cost to the Owner.

4. Review demolition methods with Owner's Representative prior to cutting or removing existing architectural and/or structural items or equipment. Repair damage to match existing.

5. Accomplish work required to pierce any waterproofing after the part piercing the waterproofing has been set in place. Seal and make watertight the openings made for this purpose.

6. Install equipment and material piercing fire walls and fire-resistant or fire-stopped walls, partitions, ceilings, and floors in a manner so the rating remains equivalent.

7. Seal weathertight equipment or components exposed to the weather.

8. Protect equipment outlets and conduit openings with factory-made plugs or caps whenever work is not in progress at that point.

B. Removal or Relocation of Materials and Equipment

1. Unless otherwise noted, remove existing electrical materials and equipment from areas indicated for demolition or where equipment is relocated. Remove materials no longer used, such as studs, straps, and conduits. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 3/4 inch below the final finished surface. Remove existing unused wires.

2. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface.

3. Removal shall comply with Section 024100.

C. Nameplates

1. Mark each individual panelboard, motor controller, disconnect switch, timer, relay, and contactor to identify each item with its respective service or function.

2. Provide a nameplate inside the door of each panelboard listing its designation, voltage, and feeder circuit number.

3. Provide a nameplate on each transformer listing its designation, voltage, feeder number, and load served.

4. Provide nameplates with engraved lettering not less than 1/4 inch high. Use black-on-white laminated plastic, attached with rivets or sheet metal screws. Do not use embossed plastic adhesive tape.

D. Warning Signs

1. Install markings, identifications, warning, caution, or instruction signs where required by NEC, NFPA 70E, and NFPA 79 paragraph 4.5.1, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect.

2. The design of safety signs and labels shall conform to ANSI Z535.4. Switchgear, panelboards, industrial control panels, motor control center, and VFD shall be field marked to warn qualified persons of potential electric arc hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment, in conformance with NEC 2005 Article 110.16.

3. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

END OF SECTION

SECTION 260519 WIRES AND CABLES LESS THAN 600 VOLTS

PART 1 - GENERAL

A. Description

This section describes materials and installation of wires and cables rated 600 volts and below.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 260500.

2. Grounding and Bonding: 260526.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit material list for each conductor type. Indicate insulation material, conductor material, voltage rating, manufacturer, and other data pertinent to the specific cable, such as shielding, number of pairs, and applicable standards.

PART 2 - MATERIALS

A. Low-Voltage Building Wire

1. Conductor material shall be copper.

2. Low-voltage building wire for use at 600 volts or less shall be 600-volt insulated, Type XHHW or THWN, and rated for continuous operation at 75°C.

3. Use No. 12 AWG minimum conductor size for power and lighting circuits.

4. Use No. 14 AWG minimum conductor size for control circuits.

5. Conductors for lighting and receptacle circuits that are No. 10 AWG and smaller shall be solid. All other conductors shall be stranded.

B. Twisted-Shielded Cable

Single-pair cables shall be two No. 18 AWG stranded tinned-copper conductors individually insulated with fully color-coded PVC rated at 600 volts; insulated conductors twisted together and shielded with a spiral-wound metal foil tape overlapped for 100% shielding. Outer jacket shall be PVC.

C. Variable-Frequency Drive (VFD) Rated Cables

1. Conductors shall be Class B stranded, uncoated annealed copper conforming to ASTM B-3 and B-8.

2. Cable shall have three Class B stranded, uncoated annealed copper ground wires conforming to ASTM B-3 and B-8.

3. The three conductors and the three ground wires shall be cabled with nonhygroscopic fillers.

4. A 5-mil uncoated copper tape shall be helically wrapped over the twisted assembly with a 50% (nominal) overlap. The shield shall be in contact with the ground wire.

5. The outer jacket shall be black, flame retardant polyvinyl (PVC) jacket meeting requirements of UL standard 1277.

D. Grounding Conductors--Bare Copper

Refer to Section 260526 for bare copper grounding conductors.

E. Conductor Tags

Provide self-extinguishing heat-shrink individual or sleeved, nonmetallic, snap-on type. Grafoplast, Phoenix Contact, Thomas & Betts sleeve markers, or equal.

F. Plastic Adhesives

Plastic adhesives for color coding shall be 7-mil minimum thick, flame-retardant, weather-resistant tape, resisting abrasion, UL rays, moisture, alkalies, solvents, and acids. Adhesives shall meet the requirements of UL 510 and CSA C22.2.

PART 3 - EXECUTION

A. Low-Voltage Building Wire Installation

1. Install wiring and cable in conduit and terminate unless otherwise noted.

2. To reduce pulling tension in long runs, coat cables with pulling compound recommended by the cable manufacturer before being pulled into conduits.

3. Remove debris and moisture from the conduits, boxes, and cabinets prior to cable installation.

4. Group conductors No. 1/0 and smaller in panelboards, cabinets, pull boxes, motor control centers, and switchboard wireways; tie with plastic ties; and fan out to terminals. Lace conductors No. 2/0 and larger with marline.

B. Identification

1. Color Coding of Low-Voltage Building Wire: Provide color coding throughout the entire network of feeders and circuits as follows:

Phase	240/120 Volts	240 Volts	480/277 Volts
Phase A	Black	Black	Brown
Phase B	Red	Red	Orange
Phase C	---	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green

2. Phase conductors No. 10 AWG and smaller and neutral/ground conductors No. 6 and smaller shall have factory color coding with solid color insulation. Do not use onsite coloring of ends of conductors or apply colored plastic adhesives in lieu of factory color coding. Larger conductors may have onsite application of colored plastic adhesives at ends of conductors and at each splice.

3. Control wires shall have colored insulation. Separate color codes for each wire shall be provided in each conduit that has up to seven wires. Conduits with more than seven wires shall have at least seven types of colored insulation.

4. Tagging of Conductors: Tag control wires and instrument cables in panels, pull boxes, wireways, and at control device. Tag control wires and instrument cables with same wire numbers as on the shop drawing submittals. Tag power wires in pull boxes and wireways where there is more than one circuit. Tag power conductors with motor control center or panelboard number and circuit numbers.

C. Low-Voltage Wire Splices

1. Solid Conductors: Use 3M "Scotchlok," Ideal "Super Nut," Buchanan B-Cap, or equal. Seal splices in underground handholes and pull boxes and in light poles with individual sealing packs of Scotchcast Brand 400 Resin or equal.

2. Stranded Conductors No. 8 and Larger: Use T & B "Locktite" connectors, Burndy Versitaps and heavy-duty connectors, O.Z. solderless connectors, or equal.

3. Stranded Conductors No. 10 and Smaller: Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors.

4. Retighten bolt-type connectors 24 to 48 hours after initial installation and before taping. Tape connections made with noninsulated-type connectors with rubber-type tape, one and one-half times the thickness of the conductor insulation, then cover with Scotch 33 tape.

D. Low-Voltage Wire Terminations

1. Terminate wires and cables at each end.

2. Provide ring tongue, nylon- or vinyl-insulated copper crimp terminals for termination on screw-type terminals, except for light switches and receptacles. Utilize installation tools recommended by the crimp manufacturer.

3. Terminal lugs shall be electro-tin plated copper compression type or spring compression type with a corrosion protection coating. Provide color-coded system on terminal and die sets to provide the correct number and location of crimps. Permanent die index number shall be embossed on completed crimp for inspection purposes.

4. Tighten screws to the value recommended by the manufacturer.

E. Field Testing

1. Perform insulation resistance test on all circuits and feeders with No. 10 size conductors and larger. Utilize a 1,000-volt d-c megohmmeter for 600-volt insulated conductors.

2. Test each complete circuit prior to energizing. Insulation resistance between conductors and between each conductor and ground shall not be less than 25 megohms. Repair or replace wires or cables in circuits that do not pass this test and repeat the test.

3. Evaluate ohmic values by comparison with conductors of same length and type.

4. Inspect shielded cables for proper shield grounding, proper terminations, and proper circuit identifications.

5. Inspect control cables for proper termination and proper circuit identification.

6. In cables terminated through window-type CTs, verify that neutrals and grounds are terminated for correct operation of protective devices.

END OF SECTION

SECTION 260526 GROUNDING AND BONDING

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of electrical grounding.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 260500.

2. Wires and Cables Less Than 600 Volts: 260519.

3. Lightning Protection Systems: 264113.

4. Gravel and Crushed Rock Base for Structures: 312323.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit material list for all grounding materials and equipment. Indicate size, material, and manufacturer.

3. Submit test results. Indicate overall resistance to ground and resistance of each electrode.

D. Performance Requirements

1. Grounding System Resistance:

a. Separately Derived Sources (as Defined by NEC 250) Grounding Electrode: 25 ohms.

b. Grounds Not Covered Above: 25 ohms.

PART 2 - MATERIALS

A. Ground Rods

Ground rods shall be copper-clad steel, 3/4 inch in diameter, minimum 10 feet long, with hardened steel points.

B. Connections

1. Ground Clamps: Clamps for connection of ground wire to ground rod shall be bronze.

2. Exothermic Connections: Provide Cadweld or equal.

C. Conductors

1. Equipment Ground: Conductors shall be low-voltage building-wire type as specified in Section 260519.

2. Bare Copper Conductors: Annealed bare copper, conforming to ASTM B3 and B8.

PART 3 - EXECUTION

A. Equipment Grounding

1. Connect the ground buses of lighting panels to the ground bus within the existing service with a grounding conductor.

2. Ground raceways and noncurrent-carrying parts of electrical equipment in accordance with NEC Article 250. Use the metallic conduit system for equipment and enclosure grounding.

3. Additionally, all circuits shall carry one ground conductor for equipment grounding. Ground conductor shall be in excess of grounding through the metallic conduit system.

B. Ground Test Well

Provide a handhole and ground rod as detailed in the drawings to aid in performing ground testing and connecting additional ground rods if required by the test results. Connect ground wire from ground rod to main service switchboard ground bus as detailed in the drawings.

C. Crushed Rock and Gravel

1. Crushed rock base and gravel are defined as natural or crushed rock, free from organic matter and containing less than 0.25% asbestos by weight or volume and meeting the following gradation:

Sieve Size	Percent Passing By Weight
1 1/2 inches	100
3/4 inch	90 to 100
No. 4	35 to 55
No. 30	10 to 30
No. 200	0 to 5

2. Durability Index shall be at least 40 per ASTM D3744.

D. Connections

Exothermic weld all underground connections.

E. Tests

Before making connections to the ground electrode, measure the resistance of the electrode to ground using a ground resistance tester specifically designed for ground resistance testing. Perform testing in accordance with test instrument manufacturer's recommendations using fall-of-potential method. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated. If a resistance less than the

performance requirements is not obtained, provide a ground rod driven 6 inches below grade spaced 10 feet away from the ground well and connect to ground test well with No. 4 AWG bare copper wire and repeat the test. If the performance requirements are still not obtained, inform the Owner for resolution.

END OF SECTION

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SECTION 260534 CONDUITS, BOXES, AND FITTINGS

PART 1 - GENERAL

A. Description

This section includes material, installation, and testing for conduit, boxes, and fittings.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 260500.
2. Grounding and Bonding: 260526.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.
2. Submit product data for the following:
    a. Conduit and fittings for each type specified.
    b. Boxes and cabinets.

D. Quality Control

1. NEMA Compliance: Comply with NEMA standards pertaining to conduits and components.
2. UL Compliance and Labeling: Comply with requirements of UL standards pertaining to electrical conduits and components. Provide conduits and components listed and labeled by UL.

PART 2 - MATERIALS

A. Rigid Steel Conduit and Fittings

1. Rigid Steel Conduit and Fittings: Conform to ASME C80.1, NEMA RN2, and UL 6, hot-dipped galvanized after threading. The zinc coating shall be flexible and not crack during bending.
2. Fittings:
    a. Locknuts: Steel or malleable iron.
    b. Bushings: Threaded type, steel or malleable iron, with 105°C rated plastic insulated throat. Plastic bushings with a temperature rating of 105°C may be used for conduits 1 inch and smaller.
    c. Box Connectors for Wet Locations: Provide a watertight threaded hub on enclosure consisting of sealing fitting with tapered conduit thread, neoprene O-ring, and 105°C rated insulating throat with grounding and bonding lug.

d. Couplings: Threaded, hot-dipped galvanized after fabrication.

3. Long-Radius Elbows (90 Degrees):

Conduit Size (inches)	Minimum Radius (inches)
3/4 through 1 1/4	12
2 and 2 1/2	15
3 and 3 1/2	18
4	30
5	36
6	42

B. PVC-Coated Rigid Steel Conduit and Fittings

1. Conduit:

a. All conduits, prior to coating, shall conform to ASME C80.1 and UL 6. Conduits shall be hot-dipped galvanized inside and out with hot galvanized threads.

b. The zinc surface shall be treated prior to coating to enhance the bond between metal and plastic.

c. Both interior and exterior of the conduit shall be coated with an epoxy acrylic primer of approximately 0.5-mil thickness.

d. The exterior coating shall be applied by dipping in liquid plastisol or other equal method that will produce a finished product conforming to NEMA 5-19-1986.

e. The thickness of the PVC coating shall be a minimum of 40 mils the full length of the conduit except the threads.

f. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.

g. Apply a chemically cured urethane coating of a thickness of 2 mils to the interior of conduit.

h. The conduit shall be bendable without damage to the PVC or urethane coatings.

i. Threads shall have an added protection of a 2-mil clear urethane coating.

j. The PVC-coated rigid galvanized steel conduit shall be certified and authorized to apply the ETL verification mark “ETL Verified to PVC-001.” ETL certified to Intertek ETL SEMKO High Temperature H2O PVC Coating Adhesion Test Procedure.

2. Fittings:

a. Coat fittings similar to the conduits.

b. Provide a loose coupling with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling, and a PVC sleeve equal to the outside diameter

of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 2 inches whichever is smaller. The wall thickness of the sleeve shall be the same as the plastic coating on the pipe.

c. The PVC coating on the coupling shall be ribbed to enhance installation.

d. Hubs shall have PVC sleeves equal to those on the couplings.

e. Screws on Form 8 fittings shall be of stainless steel with encapsulated plastic heads.

f. Size U bolts and RA clamps to fit conduit, and encapsulate the nuts in plastic.

g. Fittings shall otherwise be same as specified for rigid steel.

h. Elbows or bends exceeding 45 degrees shall be PVC coated and shall be of the same dimensions as specified for rigid steel long-radius elbows.

i. Conduit bodies, where applicable, shall be Form 8 with a tongue-in-groove (V-seal) gasket to effectively seal out corrosive elements.

3. Conduits and fittings shall conform to NEMA RN-1 and shall be manufactured by Robroy, Perma-coat, KorKap, or equal.

C. Rigid Nonmetallic Conduit (PVC) and Fittings

1. Conduit: PVC Schedule 40, 90°C rise rating, conforming to NEMA TC-2 Type EC-40 and UL 651.

2. Long-Radius Elbows (90 Degrees): Rigid PVC-coated conduit of the same dimension as specified for steel conduit.

3. Couplings, Adapters, End Bells, Expansion Couplings, Elbows, and Turns of 30 Degrees: Factory-made in accordance with NEMA TC-2 and TC-3.

4. Joint Cement: As recommended by manufacturer as suitable for the climate, furnished with instructions to achieve watertight joints.

5. Manufacturers: Carlon, Condux, or equal.

D. Liquid-Tight Flexible Metal Conduit and Fittings

1. Conduit: Steel, UL 360 listed, PVC jacketed.

2. Fittings:

a. Conform to ASME C33.84, UL listed for use with the conduit.

b. In sizes 1 1/4 inches and less, UL listed for grounding.

c. Made of steel or malleable iron, zinc plated, 105°C insulated throat, grounding and bonding lug.

E. Conduit Bodies

1. Provide types, shapes, and sizes to suit individual applications. Provide matching gasketed covers, secured with at least two captive corrosion-resistant screws.

2. Bodies connecting to rigid conduit shall be of the same material and material coating as the conduit, with metal threaded hubs. Provide with threaded covers or gasketed covers secured with at least two corrosion-resistant captive screws.

3. Bodies connecting to nonmetallic conduit shall be nonmetallic conduit bodies conforming to UL 514B.

F. Specialty Conduit Fittings

1. Expansion/Deflection Fittings for Rigid Metal Conduit: Weatherproof with an internal bonding arrangement. Provide for 3/4-inch movement in all directions. Where used for angular movement, allow for a 30-degree deflection from normal in any direction.

2. Expansion Fittings for Rigid Nonmetallic Conduit: O-ring type with at least two rings, allowing for a minimum conduit movement of 6 inches.

G. Junction and Pull Boxes

1. Provide factory-made standard sizes, and shop fabricate when nonstandard size boxes are shown or are required. Comply with UL and NEMA standards.

2. NEMA 1: Sheet steel, hot-dipped galvanized after fabrication. Finish with one coat of metal primer and one coat of primer sealer.

3. NEMA Type 4X: Type 304 stainless steel or fiberglass, with gasketed covers and Type 304 stainless steel bolts or screws.

4. NEMA 4: Code gauge steel, hot-dipped galvanized after fabrication. Provide cover with Type 303 stainless steel bolts.

5. Junction boxes shall be manufactured by Hoffman, Wiegmann, or equal.

H. Conduit Sealant

1. Moisture Barrier Types: Sealant shall be a nontoxic, nonshrink, nonhardening, putty-type hand-applied material providing an effective barrier under submerged conditions.

2. Fire-Retardant Types: Fire stop material shall be a reusable, nontoxic, asbestos-free, expanding, putty-type material with a three-hour rating in accordance with UL 35L4.

PART 3 - EXECUTION

A. Conduit Usage Schedule

Install the following types of conduits and fittings in locations listed, unless otherwise noted in the drawings. Definitions and requirements of NEC apply unless specifically modified below. Refer to Section 260500 for definitions of locations.

1. Exterior, Exposed:

a. Material: Rigid steel conduit.

b. Minimum Size: 3/4 inch.

2. Exposed, Where Area is Indicated as Corrosive Location:

a. Material: PVC-coated rigid steel conduit.

b. Minimum Size: 3/4 inch.

3. Interior, Exposed, Dry, and Wet Locations:

a. Material: Rigid steel conduit.

b. Minimum Size: 3/4 inch.

4. Interior, Dry Locations:

a. Material: Rigid steel conduit.

b. Minimum Size: 3/4 inch.

5. Embedded in Concrete:

a. Material: Rigid steel conduit.

b. Minimum Size: 3/4 inch.

6. In Earth, Below Concrete Slabs or Underground:

a. Material: Rigid nonmetallic conduit (PVC).

b. Minimum Size: 3/4 inch.

c. Conduit Stub-Ups: Provide PVC-coated rigid steel conduit long-radius elbows for stub-ups which connect to underground rigid PVC conduit. Extensions from elbows above grade shall be PVC-coated rigid steel for a minimum of 6 inches above grade. Stub-ups into free-standing electrical gear, such as free-standing VFDs, may be Schedule 40 rigid PVC conduit, in which case terminate the conduits with appropriate end bells.

7. Final Connections to Motors, Transformers, or Instruments:

a. Material: Liquid-tight flexible conduit.

b. Minimum Size: 3/4 inch.

c. Length of liquid-tight flexible conduit shall be 5 feet or less, unless field conditions require longer lengths.

B. Junction and Pull Boxes--Usage Schedule

Install the following type of boxes in locations listed, unless otherwise noted in the drawings. Refer to Section 260500 for definitions of locations:

1. Exterior: NEMA 4.

2. Interior, Dry: NEMA 1.

3. Corrosive: NEMA 4X.

C. Conduit Fill

For runs that are not sized in drawings, compute the maximum conduit fill using NEC requirements for Type THW conductors (larger if applicable), although the actual wiring may be with types of conductors having smaller cross-sections.

D. Conduit Installation, General

1. Install conduit concealed unless specifically noted otherwise.

2. Run exposed conduits parallel and perpendicular to surface or exposed structural members and follow surface contours as much as practicable to provide a neat appearance.

3. Make right-angle bends in conduit runs with long-radius elbows or conduits bent to radii not less than those specified for long-radius elbows.

4. Make bends and offsets so that the inside diameter of conduit is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

5. Cap all conduits immediately after installation to prevent entrance of foreign matter.

6. Do not use diagonal runs except when specifically noted in the drawings.

7. Route exposed conduit to preserve headroom, access space, and work space.

8. Treat threaded joints of rigid steel conduit with T&B "Kopr-Shield" before installing fittings where conduit is in slabs and other damp or corrosive areas.

9. For PVC-coated rigid conduits, use manufacturer's recommended installation tools and recommendations. The manufacturer shall certify the installer before installation can proceed.

10. Conduit Terminations:

    a. Terminate conduits with locknuts and bushings except where threaded hubs are specified.

    b. Install conduits squarely to the box and provide one locknut outside the box and one locknut and bushing inside the box.

    c. Install locknuts with dished side against the box.

    d. When terminating in threaded hubs, screw the conduit or fitting tight into the hub so that the end bears against the fire protection shoulder.

    e. When chase nipples are used, install conduits and coupling square to the box and tighten the chase nipple leaving no exposed threads.

11. Install exposed, parallel, or banked conduits together. Make bends in parallel or banked runs from the same centerline so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel.

12. Conduit runs are shown schematically. Supports, pull boxes, junction boxes, and other ancillary equipment are not usually shown in drawings. If not shown, provide as required by NEC except that there shall not be more than the equivalent of three quarter bends (270 degrees) total between underground pull points. Provide additional boxes to permit pulling of wires without damage to the conductors or insulation.

13. Locations of conduit stub-ups shown in the drawings are schematic. Coordinate these locations with conduit entries of actual equipment served.

E. Requirements for Rigid Nonmetallic (PVC) Conduit

1. Comply with the installation provisions of NEMA TC-2, except as modified below.

2. Make cuts with a fine tooth handsaw. For sizes 2 inches and larger, use a miter box or similar saw guide to assure a square cut.

3. Use factory-made couplings for joining conduit.

4. Cementing and joining operation shall not exceed 20 seconds. Do not disturb joint for 5 minutes, longer (up to 10 minutes) at lower temperatures. Make joints watertight. Joining procedure shall conform to the procedures of ASTM D2855.

5. Install expansion fittings. Expansion fittings are required when the conduit is left exposed in trenches for a period of time during which the conduit's temperature can vary more than 2 degrees. Install expansion fittings near the fixed end of the run and 100 feet on center.

F. Conduit Sealing

1. Seal conduit entries with conduit sealant as follows:

   a. When conduit leaves an area identified as corrosive.

   b. Conduits exiting buildings and underground structures.

G. Grounding

1. Provide grounding in accordance with Section 260526.

2. Use grounding bushings for all conduits carrying a grounding conductor.

3. Provide a grounding conductor in flexible conduit, size conforming to NEC Article 250.

H. Conduits Embedded in Concrete and Below Slabs

1. Install conduits and sleeves passing through slabs, walls, columns, or beams so as not to impair the strength of construction. Secure conduit to prevent sagging or shifting during concrete pour.

2. Conduits larger than 1 1/2 inches in diameter may be embedded in structural concrete only after submittal and review of location and reinforcement details.

3. Conduits and sleeves may be installed without specific permission, provided:

   a. They are 1 1/2 inches or less in diameter, are spaced not less than three diameters on centers, and conform to paragraph 2 or 3 below.

   b. Conduits, including fittings, which are embedded within a column, do not displace more than 4% of the cross-sectional area on which structural strength is calculated.

   c. Conduits and sleeves, embedded within a wall, slab, or beam, are not larger in the outside dimension than one-third the overall thickness of wall, slab, or beam in which they are embedded.

   d. There is a minimum of 1 1/2 inches between the conduit and reinforcement for slab and wall penetrations.

4. Install conduits in slabs other than slabs-on-grade as close to the middle of the slabs as practical without disturbing the reinforcement. Outside diameter of the conduit shall not exceed one-third times the slab thickness. Do not space parallel runs of conduit closer than three diameters on centers, except at cabinet and outlet box locations.

5. Conduits shown in or under slab-on-grade construction shall be installed below the floor slab and under curing or damp-proofing membranes. An exception may be made for conduit with an outside diameter not larger than 25% of the slab thickness, in which case, standards applying to slabs other than slab-on-grade may be used.

I. Conduits Underground

Where PVC conduit is installed underground in locations other than under concrete slab, provide 24-inch minimum cover. Provide 3-inch minimum sand above and below conduits. Maintain a 12-inch minimum separation between conduit and other systems. Pitch conduit to drain away from buildings.

J. Conduit Supports

1. Support conduit at intervals and at locations as required by the NEC. Do not use perforated strap or plumber’s tape for conduit supports.

2. Suspended Conduit: Use malleable iron, factory-made, split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter); Anvil, Cooper B-Line, Unistrut, Superstrut, or equal. For grouped conduits, construct racks with threaded rods and tiered angle-iron or preformed channel cross members. Construct channel to limit deflection to 1/200 of span. Clamp each conduit individually to a cross member. Where rods are more than 2 feet long, provide rigid sway bracing.

3. Where area or room is identified as "Corrosive Location," supports, hangers, preformed channels, and clamps shall be Type 304 stainless steel, PVC-coated steel, or fiberglass. Fiberglass support system shall be as manufactured by Omnistrut, Click, or equal. Bolts and nuts for stainless steel and PVC-coated support systems shall be Type 304 stainless steel.

K. Conduit Penetrations

1. Unless otherwise indicated, dry-pack around conduits which penetrate concrete walls, floors, or ceilings.

2. Conduits passing vertically through concrete slabs and through structural beams shall be sleeved, except where sealing and expansion/deflection fittings are required. Pack sleeves through floors and fire-rated walls with fire-rated packing. Nonrated penetrations may be packed with nonshrink grout.

3. Install conduits passing through building sidewalls with expansion/deflection fittings.

4. Maintain the integrity of damp-proofing and waterproofing membranes that are penetrated by conduits and boxes.

5. Buried conduit shall penetrate surface at right angle.

6. Conduits transitioning from underground to an existing building shall stub up adjacent to the building, run exposed vertically to ceiling height and penetrate wall using an LB fitting. Conduits may penetrate at a lesser height when entering wireways.

L. Damaged Conduit

1. Repair or replace conduit damaged during or after installation.

2. Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.

3. Repair cuts, nicks, or abrasions in the zinc coating of galvanized conduit with galvanizing repair stick, Enterprise Galvanizing "Galvabra" or equal.

4. Repair cuts, nicks, or abrasions in the PVC coating of PVC-coated conduit with the manufacturer's recommended PVC material and build up surface thickness to match the factory coating thickness and color.

M. Empty Conduit

1. Provide 200-pound strength pull cord in all empty conduits.

2. Provide a waterproof label on each end of the pull cords to indicate the destination of the other end.

N. Outlets for General Wiring

1. Mount outlets for different conduit systems shown in the same wall area not more than 6 inches on center.

2. Locate switch boxes 4 inches from doorjamb.

3. Rigidly support boxes for wall and ceiling outlets and finish flush and straight. Front edge shall be within 1/8 inch of finished surface and plumb within 1/8 inch.

4. Install outlets in exposed masonry and tile walls, with square corner boxes or standard boxes with square corner extensions that are sufficiently deep so that conduit offsets are not required. Saw cut openings in exposed masonry and tile walls with an opening tolerance of 1/8 inch on all sides, placing bottom of box at nearest masonry joint to specified mounting height. For other wall finishes, install with plaster or other rings. Do not activate any outlet unless these installation requirements are met.

5. Install outlets and boxes securely and support them substantially.

O. Equipment Supports

Support wall-mounted junction boxes, pull box enclosures, and panels in wet and corrosive locations with Type 304 stainless steel preformed channels and Type 304 stainless steel concrete anchors.

P. Adjusting and Cleaning

Upon completion of installation of conduits and boxes, inspect interiors of conduits and boxes; clear blockages; and remove burrs, dirt, and construction debris.

END OF SECTION

SECTION 260548 SEISMIC RESTRAINT FOR ELECTRICAL EQUIPMENT

PART 1 - GENERAL

A. Description

This section describes the requirements for furnishing and installing seismic restraint devices for electrical equipment.

B. Related Work Specified Elsewhere

When it applies, this section is referenced in other sections of the specifications.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit seismic anchoring calculations with equipment submittals. Calculations shall be performed by a licensed structural engineer employed by the equipment manufacturer and registered in the state of California.

3. Submit equipment anchoring methods. Include anchoring locations, anchor types, and minimum anchor embedment depths. Anchors shall have ICC-approved anchorage values.

D. Project-Specific Criteria

1. Importance Factor, Ip: 1.5.

2. Occupancy Category: III.

3. Seismic Design Category: D.

4. Site Class: D.

5. S_{DS}: 0.648.

6. S_{D1}: 0.372.

7. Ap and Rp per ASCE Table 13.6-1.

PART 2 - MATERIALS

A. Seismic Design of Equipment

Equipment fabricated or assembled at manufacturers' premises shall be designed and constructed in such a manner that all portions, elements, subassemblies, and/or parts of said equipment and the equipment as a whole, including their attachments, shall have the capability of withstanding seismic forces specified under "Seismic Anchoring and Restraints" below.

B. Seismic Anchoring and Restraints

Equipment Anchors: Electrical equipment shall be securely anchored. Anchoring shall have the capability of withstanding seismic forces per Section 16 of the California Building Code (CBC) and ASCE 7-05, Chapter 13.

PART 3 - EXECUTION

A. Equipment

Install equipment anchors in accordance with the final shop drawing and manufacturer's recommendations. Properly torque all bolts to the required values.

END OF SECTION

SECTION 260590 MISCELLANEOUS ELECTRICAL DEVICES

PART 1 - GENERAL

A. Description

This section includes materials and installation of miscellaneous electrical devices and equipment such as flood level switches, and intrusion alarm switches.

B. Related Work Specified Elsewhere

General Electrical Requirements: 260500.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit ratings and characteristics including voltage ratings, continuous current ratings, conduit entry restrictions, and enclosure type and dimensions.

PART 2 - MATERIALS

A. Thermostats

1. Thermostats shall be line voltage type, with 70°F to 140°F set point range and motor current rated contacts. Provide Honeywell T631A-1022 or equal.

2. Provide switch subbase with auto-off-on selector switch rated at 8 amperes minimum at 120 volts. Provide appropriate switch label. Provide Honeywell Q651A 1009 or equal.

B. Flood Level Switches

Switches shall be float-actuated type, designed specifically for flood alarm applications. Provide snap-action type, single-pole, double-throw switch contacts rated for 20 VA at 120-volt ac. Housing shall be NEMA 4 watertight construction with stainless steel for wetted components. Float actuator shall be enclosed in a perforated stainless steel envelope. Flood level switches shall be GEMS Model LS-1900 or equal.

C. Intrusion Alarm Switches

1. Provide heavy-duty, precision turret-head type limit switches with one normally open and one normally closed contact along with an adjustable lever arm with oil-impregnated sintered iron roller.

2. Provide a Square D, Class 9007, Type C switch or equal.

PART 3 - EXECUTION

A. Installing Intrusion Alarm Switches

The switches shall be interfaced with the RTU. Mount switch on inside door frame such that when the door is opened, the normally open switch contacts shall close and, when door is closed, the normally open switch contacts shall open.

B. Field Testing

Flood Level Switches: Verify controls by manually lifting float and checking correct control response.

END OF SECTION

SECTION 261216 DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

A. Description

This section includes materials and installation of transformers.

B. Related Work Specified Elsewhere

General Electrical Requirements: 260500.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit ratings and characteristics including voltage, phases, connections, enclosure type and dimensions, and conduit entry restrictions.

PART 2 - MATERIALS

A. General

1. Provide general-purpose, single-phase and three-phase, individually mounted dry-type transformers of the two-winding, self-cooled type. Kva size, voltage, and phase of the transformers are indicated in the drawings.

2. Transformers shall have copper windings and shall be UL listed and labeled where listing applies.

3. Transformers shall be rated for continuous operation in a 40°C maximum ambient temperature.

B. Dry-Type Transformers (10 kva and Below)

1. Construct transformers in accordance with ANSI C89.2, NEMA ST-20, and UL listed under the requirements of UL 506.

2. Transformers 5 kva and larger shall have two 5% FCBN taps on the primary side.

3. Encapsulate core and coil in an insulating resin of the class equal to the temperature rise and embed in a resin and filler system to attenuate the sound level.

4. Transformer shall be totally enclosed, nonventilated, suitable for indoor or outdoor installation.

5. Transformers shall be Sorgel Electric Division, Square D Company "Quiet Quality"; General Electric Company "QB," "ML," or "QMS"; Cutler-Hammer "EP", or "EPT"; or equal.

C. Factory Tests

Perform factory tests in accordance with the latest revisions of ANSI C57.12.91 for dry-type transformers.

PART 3 - EXECUTION

A. General

1. Set taps under load conditions for correct voltage.

2. Install transformers, 5 kva and larger, on Korfund Series F or H double-deflection mounts selected for the weight of the transformer, to produce the maximum isolation. Provide seismic restraints designed in accordance with UBC building code.

3. Install transformers such that no metal-to-metal, concrete, plaster, or wood contact exists between the transformer and structural members.

4. Make conduit connections to transformers with liquid-tight flexible conduit utilizing neoprene gaskets and isolated grounding bushings at the transformer enclosures, to achieve complete metal-to-metal sound and vibration isolation. Install flexible jumpers for grounding continuity from enclosure to conduits.

B. Tests

Transformers shall have insulation resistance tests made on the windings prior to being connected. The measurements shall be from primary and secondary windings to ground and between primary and secondary windings. The minimum value shall be 10 megohms.

END OF SECTION

SECTION 262410 PANELBOARDS

PART 1 - GENERAL

A. Description

This section describes materials, testing, and installation of panelboards.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 260500.

2. Dry-Type Transformers: 261216.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Show ratings and characteristics including voltage ratings, busing arrangement, continuous current ratings, fault current withstand ratings, neutral bus rating, enclosure type, ratings and arrangement of overcurrent protective devices, and mounting provisions.

3. Submit outline and dimensional drawings and conduit entry restrictions.

PART 2 - MATERIALS

A. General

1. Panelboards shall comply with NEMA PB 1 (panelboards) and UL 67 (electric panelboards) requirements.

2. Provide dead-front, safety-type panelboards with ratings as scheduled. Panelboards shall be circuit-breaker type and shall be fully rated for short-circuit capacity indicated in the drawings. Panelboards shall be UL listed and labeled and manufactured by General Electric, Cutler-Hammer, Square D, Siemens, or equal.

B. Cabinets

Enclose panelboards located indoors in NEMA 1 single sheet metal cabinet with hinged front doors, catches, and locks. Provide holder for the directory on the inside of the door.

C. Breakers

1. Breakers shall be molded-case type and shall comply with NEMA AB3 requirements. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide trip ratings as indicated in the panelboard schedules.

2. Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multiple circuit breakers shall be of the common-trip type having a single operating handle.

3. Provide HACR-type breakers where indicated in the drawings or when protection of HVAC equipment is required.

D. Breaker Connections

Circuit breaker current-carrying connections to the bus shall be bolted type.

E. Bus Bars

Bus bars shall be copper. Provide a copper ground bus bar installed on the panelboard frame, bonded to the box, and containing a number of terminal screws equal to or greater than the maximum number of branch circuits. For panelboards with neutrals, provide full-size neutral bus bar, unless otherwise noted in the drawings, and suitable lugs to support maximum number of circuits.

F. Space

Where "space" is noted in the panelboard schedules in the drawings, provide connectors and mounting brackets for the future insertion of a 20-ampere, single-pole overcurrent device.

G. Directories

Provide typed circuit directories on the inside face of the door of each panel. Do not provide handwritten directories.

H. Nameplates

Provide nameplates as specified in Section 260500. Designate the identifying nomenclature, voltage, and phase of the panel as shown in the drawings; for example, "PANEL LA, 277/480-volt, 3-phase, 4-wire, 225-ampere bus."

PART 3 - EXECUTION

A. Accessibility

Install panelboards so that the top of the highest circuit breaker is not more than 6 feet 6 inches above the floor or working platform.

B. Tests

Operate each circuit breaker and verify that all phases of each load are disconnected.

END OF SECTION

SECTION 262650 ELECTRIC MOTORS

PART 1 - GENERAL

A. Description

This section describes materials, installation, and testing of induction motors and applies to motors that are provided as part of equipment specified in other sections. When it applies, this section is referenced in those other sections.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 260500.

2. Variable Frequency Drive (VFD): 262923.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions

2. Show complete nameplate data, ratings, characteristics, mounting arrangements, size and location of conduit entry, location and size of grounding lug, and coatings.

3. For premium-efficiency motors (Suffix E), provide percent efficiency data at full, 75%, and 50% load.

4. Submit factory test results for well motor.

D. Factory Tests

For each integral horsepower motor provide routine (short commercial) test data. Tests shall comply with NEMA MG 1-12.55.

E. Controller Coordination

When motors furnished differ from the ratings indicated, notify controller manufacturer to make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment.

F. Quality Control

NEMA Compliance: Unless otherwise indicated, comply with NEMA MG 1.

PART 2 - MATERIALS

A. General Motor Design Requirements

1. Unless otherwise specified or specifically required by the manufacturer of the equipment to be driven, a-c motors shall be single speed, squirrel cage induction type. Small and medium size motors per NEMA MG 1, Section II shall be NEMA Design B. Large size motors per NEMA MG 1, Section III shall be standard torque type. Motors 15 horsepower and larger

shall be NEMA Starting Code F or G. Motors smaller than 15 horsepower may have manufacturer's standard starting characteristics.

2. Stator windings shall be copper.

3. If motors are subjected to overhanging loads, they shall be designed for such loads. The magnitude of the overhanging load shall not exceed the recommendations of the motor manufacturer.

4. The connected load (maximum horsepower required) of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any operating condition.

5. Size motors to start and accelerate the design load of the driven equipment without exceeding any of the specified design requirements. Replace or repair any motor failing these requirements with a motor that will meet the specifications and requirements.

6. Connection box shall be cast metal with gaskets between the box and housing and between the box and cover. Provide a grounding terminal in the connection box.

7. Conduit opening at the motor connection box shall be coordinated with the incoming conduit sizes and provided accordingly.

8. Open dripproof and weather-protected motors shall have a service factor of 1.15 on sinusoidal power and 1.0 on inverter power, such as power from a VFD. Totally enclosed motors shall have a service factor of 1.0, unless a higher service factor is standard for the operating duty.

9. Unless otherwise noted, motors shall be rated for continuous duty at an ambient temperature of 50°C and at an elevation of 3,300 feet.

10. Open dripproof and weather-protected motors 7.5 horsepower and larger shall have stainless steel screens over openings.

11. Motors 7.5 horsepower and larger shall have cast-iron frames. Do not provide aluminum frames.

12. For motors controlled by VFDs, the critical vibration speed of the motor/load combination shall either not fall within the operating range of the VFD or such frequency shall be blocked with the VFD critical speed avoidance circuit.

B. Bearings

1. Horizontal Motors:

   a. Bearings for motors up to 1 horsepower shall be sealed, permanently lubricated ball bearings.

   b. Bearings for motors 1 horsepower and larger shall be shielded open-type ball bearings installed in labyrinth sealed end bells with pipe plugs, or shielded type. Bearings shall be regreasable and have provisions for purging old grease.

2. Vertical Motors:

   a. Design vertical motors for vertical operation and shall have thrust bearings with a rated L-10 life of 40,000 hours as defined by AFBMA.

b. Thrust bearings for motors 75 horsepower and larger shall be oil lubricated. Guide bearings may be antifriction, grease lubricated, or oil lubricated.

c. Equip grease-lubricated bearings with fittings in each bearing housing. Fittings shall be accessible without removal of any covers or guards. Provide drains to prevent overlubrication.

C. Insulation and Temperature Rise

Unless otherwise noted, provide Class F insulation with Class B rise requirements, per NEMA MG 1-12.43, at the specified service factor.

D. Coating

1. Do not coat cast aluminum frame motors.

2. Motors housed within equipment enclosures, such as exhaust fans and air conditioners, may have factory's standard prime and finish coats.

3. Coat cast-iron frame motors. Apply prime coat at the factory which shall be compatible with field-applied finish coat(s).

4. Field apply finish coat(s) specified in the applicable equipment section.

E. Noise Levels

Unless quieter type motors are specified, motors shall have no-load sound power levels not to exceed the values specified in NEMA MG 1, Section I, Part 9.

F. Efficiency

Unless otherwise specified, motors 1 horsepower and larger shall be classified as “Energy Efficient” and shall have minimum guaranteed full load efficiencies in accordance with NEMA MG 1-12.59. The efficiency shall be determined in accordance with NEMA MG 1-12.58.

G. Motor Types

Motor designations consist of type number and suffix letter. The number and letter are intended to be compatible and the motor shall meet the requirements of both.

1. Type 1: Vertical weather-protected Type 1, NEMA WP-1.

2. Suffix E: Motors shall be classified as “Premium Efficient” and shall have minimum guaranteed full load efficiencies in accordance with NEMA MG 1-12.60. The efficiency shall be determined by IEEE 112 Method B using sine wave power for motors up to 300 horsepower and Method F for motors above 300 horsepower. Efficiency shall be listed on the nameplate in accordance with NEMA MG 1-12.58.2.

3. Suffix H: Motor shall have 120-volt heating elements.

4. Suffix N: Provide motor with a guaranteed maximum sound power level of 72 dBA, measured per IEEE 85, when running at no-load connected to sine wave power.

5. Suffix R: Equip motor with a nonreversing ratchet.

6. Suffix T:

   a. Equip motor with thermal protection in accordance with NEMA MG 1. Control leads shall be color-coded, brought out to the motor conduit box or a separate terminal box for connection.

   b. Provide three series-connected, normally closed switches, one in each winding.

7. Suffix V: Motor shall be inverter rated in accordance with NEMA MG-1.31 and shall be suitable for use with a pulse width modulated VFD with nonfiltered output. Design the motor to limit temperature rise to within the specified requirement at a 1.0 service factor when powered from the drive. Provide a nameplate on the motor stating that it is rated for VFD applications. Provide bearing insulation and properly grounded shaft as specified under paragraph 2.02 of this section.

H. Manufacturer

Motors shall be manufactured in the United States by Toshiba, U.S. Motors, Weg Motors, GE Motors, Siemens, or equal.

PART 3 - EXECUTION

A. Storage

1. Protect motors from exposure of elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters (Suffix H).

2. Store motors in an air-conditioned, ventilated, or protected environment similar to or better than the environment in their final location.

B. Field Operating Tests

1. Perform NETA a-c induction motor acceptance tests. Include optional tests.

2. Run each motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed, and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

3. Include measured running current of each phase of motors 1/2 horsepower and larger in the maintenance manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

C. Vibration Tests

1. Where indicated, conduct a vibration test in the field after the installation has been completed. The test shall be conducted for each motor when specifically noted or when ordered by the Owner in cases of discernible abnormal vibration.

2. For vertical motors, measure N-S and E-W vibration at front and rear of upper and lower bearing housing.

END OF SECTION

SECTION 262923 VARIABLE FREQUENCY DRIVE (VFD)

PART 1 - GENERAL

A. Description

This section describes materials, testing, and installation of VFD for pumping applications.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 260500.

2. Seismic Restraint for Electrical Equipment: 260548.

3. Electric Motors: 262650.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's descriptive data including ratings, performance and operational features, dimensional data, conduit entry restrictions, and heat dissipation to ambient.

3. Submit a schematic diagram for each drive showing field devices, wire numbers, terminal numbers, and interface with other panels.

4. Submit control schematic diagrams in a “ladder diagram” format that satisfies the following minimum requirements:

a. Show unique rung numbers on left side of each rung. Provide unique wire numbers for all wires between terminals.

b. Show terminal numbers for all devices, relays, timers, contacts, etc.

c. Where the internal wiring diagrams of subassemblies are furnished on separate sheets, show as a rectangle in the schematic diagram with external points identified and cross-referenced to the separate sheets of the control circuit. Show coils and contacts internal to the subassemblies in the rectangle connected to their terminal points.

d. Use a cross-referencing system in conjunction with each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet. Show spare contacts.

e. Show symbols of external field devices on the schematic (ladder) diagram with utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position. If the equipment is shown in a specific position, identify the position.

f. Show contacts of multiple contact devices, e.g., selector switches, on the line of the schematic diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow. This does not

apply to control relays, starters, or contactors. Use additional charts or diagrams to indicate the position of multiple contact devices.

g. Show the purpose or function of switches adjacent to the symbols. Show the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram on the right side of the respective rung.

h. The VFD manufacturer shall review the control schematic diagrams provided in the drawings, shall identify any adjustments that might be required to achieve the intended control features described in the drawings, and shall implement such changes, prior to shipping the equipment. If further adjustments are required, make such adjustments in the field, with the consent of the Owner's Representative.

5. Submit harmonic analysis.

6. Submit certified factory test report.

7. Submit a confirmation of appropriate coordination with motor manufacturer regarding adequate mitigation against bearing damage caused by currents that may flow in the bearings due to shaft voltages imposed by the VFD controller.

D. Operation and Maintenance Manuals

Submit operation and maintenance manuals in accordance with Section 260500.

E. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded, for a certified technical representative:

1. One labor day to check the installation, calibrate the drives, and advise during start-up and testing of the drives.

2. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

F. Service Organization Qualifications

1. The service organization office shall be located within 100 miles of the jobsite.

2. The service organization must have been an authorized service organization of the equipment manufacturer for the past 12 months. Service engineers or technicians must be factory trained.

3. Maintain a spare parts inventory of 100% of the controller components.

G. Ratings

Motor horsepower ratings shown are minimum expected. This does not limit the equipment size. When motors furnished differ from the minimum ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, VFD sizes, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner.

PART 2 - MATERIALS

A. General

1. VFD shall consist of variable frequency controller, input circuit breaker, and controls. VFD shall operate as a simplex unit with no interaction with other drives. Horsepower rating of each drive shall be sufficient to drive the motor as shown in the drawings or the motors actually provided, whichever is larger, under the specified operating conditions.

2. All components shall be integral to the VFD lineup, factory wired, and tested as a complete system.

3. Design equipment to operate under the following operating conditions:

   a. Elevation to 3,300 feet above sea level.

   b. Ambient 0°C to 50°C.

   c. Noncondensing relative humidity to 95%.

   d. A-C line frequency variation of ±3 hertz.

4. VFD shall maintain a 0.95 minimum true power factor throughout the entire speed range.

5. VFD shall be suitable for use with any standard NEMA-B squirrel-cage induction motor having a 1.15 service factor. Provide equipment for proper operation of motor and drive when required due to motor feeder length.

6. Equipment shall comply with the requirements of ANSI, IEEE, and NEMA. The electrical equipment, design, and construction shall comply with the provisions of the NEC. The complete drive shall be UL listed.

7. All drives shall be supplied by one manufacturer.

8. VFDs shall be manufactured by ABB, Toshiba, Robicon, Cutler-Hammer, Allen Bradley, or equal.

B. Enclosures

1. Equipment enclosure shall be floor standing, unless otherwise noted in the drawings, completely front accessible, ventilated NEMA 12. Enclosures shall be suitable for mounting against a wall or back-to-back with other equipment.

2. Provide separate enclosures for each variable frequency controller. Locate output isolation contactors, harmonic suppression equipment, and controls either within the variable frequency controller enclosure or in an adjacent enclosure.

3. Verify that overall equipment dimensions are within the dimensions indicated in the drawings. If larger equipment is required, submit a proposed room layout showing arrangement of electrical equipment. Provide working clearances in accordance with the NEC. Any costs due to rearrangement of equipment shall be borne by the Contractor with no additional expense to the Owner.

4. Provide additional pull sections as required for bottom entry of incoming and/or outgoing cables.

C. Variable Frequency Controllers

1. Controller shall consist of an input rectifier-grade phase-shifting transformer with 18-pulse minimum converter section and output filters as required.

2. Controller shall be pulse width modulated design.

3. Controller shall be variable voltage/variable frequency (constant volts per hertz).

4. The controller shall include the following features:

   a. 460-volt a-c, +10%, -10% (at rated load), 3-phase, 3-wire, 60-hertz input power.

   b. 460-volt a-c, 3-phase, 3-wire, ungrounded output power.

   c. Equipment fault current rating of 65,000 symmetrical amperes fault current.

   d. Input power surge protector.

   e. 20- to 60-hertz continuous operating range.

   f. 115% overload rating for 100 seconds, 100% rated current continuous.

   g. Output current limit, 50% to 110% adjustable. Limits motor inrush current during start-up.

   h. Regulation ±3% of base speed.

   i. Voltage Dip Ride-Through: Controller shall be capable of sustaining continued operation with a 40% dip in nominal line voltage. Output speed may decline only if current limit rating of the controller is exceeded.

   j. Power Loss Ride-Through: Controller shall be capable of a minimum three-cycle power loss ride-through without fault activation.

   k. Separately adjustable acceleration and deceleration rates.

   l. Maximum and minimum speed adjustments.

   m. 120-volt a-c control power for run/stop circuits.

   n. Blower cooled, with thermal switch cutout.

   o. Comprehensive microprocessor-based digital diagnostic system that monitors its own control functions and displays faults and operating conditions in plain English without the use of codes. The digital keypad and display shall be a membrane keypad with integral 24-character minimum LCD display capable of controlling the VFD and setting drive parameters. Include self-test software program to verify proper keypad operations. A fault log shall record, store, display, and print, upon demand, the following for the 15 or more most recent events:

      (1) VFD mode (auto/manual).

      (2) Elapsed time (since previous fault) or fault time.

(3) Type of fault.

p. The following digital indications shall be possible to be selectively displayed:

(1) Speed called for by incoming process signal in percent of full speed.

(2) Output current in amperes.

(3) Output frequency in hertz.

(4) Input voltage.

(5) Output voltage.

(6) Total 3-phase kilowatts.

(7) Kilowatt-hour.

(8) Elapsed time.

(9) rpm.

(10) D-C bus voltage.

q. Password security shall be available to protect drive parameters from unauthorized personnel.

r. Provide a plain English user menu in software in nonvolatile memory as a guide to parameter setting.

s. VFD parameters, fault log, and diagnostic log shall be downloadable via RS-232 as well as line-by-line on the keypad display.

5. Minimum controller efficiency shall be 96% at 100% speed and 100% torque and 88% at 50% speed and 25% torque based on nominal 1,800-rpm motor with load horsepower to vary as cube of speed.

6. The controller shall include protective circuitry that initiates an orderly shutdown of the inverter without component failure. The controller shall shut down and require manual reset for the following fault conditions:

a. Motor inverse time overload.

b. Instantaneous overcurrent.

c. Inverter fault.

d. Overfrequency.

e. D-C link overvoltage.

f. Ground fault.

7. The controller shall ride through or shut down for the following fault conditions.

a. Incorrect phase sequence.

b. Loss of an input phase.

8. The controller shall shut down for input undervoltage. The controller shall automatically restart upon a cleared fault condition.

9. The controller shall have not less than five restart capabilities. If the drive reaches the limits of restart, the restart circuit shall lock out and shall provide a fault signal.

10. Provide a common failure contact for remote indication of fault conditions previously listed.

11. The power circuit design shall be such that the following fault conditions can occur without damage to the power circuit components:

a. Single-phase fault or 3-phase short circuit on VFD output terminals.

b. Failure to commutate inverter transistor due to severe overload or other conditions.

c. Disconnecting motor during VFD operation.

d. Loss of input power due to opening of VFD input disconnect device or utility power failure during VFD operation.

e. Loss of one phase of input power.

12. VFD shall have integral modbus communication capability.

13. Phase-shift transformers shall be ventilated, dry type with 80°C temperature rise.

14. Provide a critical speed avoidance circuit for selection of a critical speed with a rejection band centered on that speed. The drive shall ignore any speed signals requiring drive operation within the rejection band.

15. The VFD controller shall operate satisfactorily when connected to a bus subject to a total harmonic voltage distortion caused by other sources of up to 10% and commutation notches of up to 36,500 microsecond-volts.

D. Input Circuit Breaker

1. Circuit breaker shall be molded-case or insulated-case type, mechanically interlocked with the enclosure door to provide positive disconnect of incoming a-c power.

2. Make provisions for padlocking external disconnect handles in the off position.

E. Controls

1. Provide control circuit transformers, indicating lights, selector switches, push buttons, elapsed time meter, analog dial-type speed indicator, digital keypad, and display as indicated in the schematic diagrams shown in the drawings.

2. Mount and wire the devices listed above, other than the control transformer, on the controller cabinet door.

F. Relays

1. Provide relays with the number of contacts shown on the schematic diagrams. Utilize additional contact blocks or relays to satisfy the required number of contacts shown at no additional cost to the Owner.

2. Control relays shall be magnetically held. Control relays shall be UL listed with NEMA A300 rated contacts. Coil voltage, number of poles, and pole arrangement shall be as indicated in the drawings. Relays may be plug-in type with retaining clips, check button for test operation, and indicating light for coil power indication. Relays shall be Allen-Bradley Bulletin 700, Cutler-Hammer Type Westinghouse Type AR, Idec RR Series, or equal.

3. Time-delay relays shall be UL listed with contacts rated 10-ampere noninductive load, 120 volts, with coil voltage, number of poles, pole arrangement, and maximum timing adjustment as indicated in the drawings. Relays shall be solid-state nonplug-in industrial type. Provide Square D Class 9050, Type FS; Allen Bradley Bulletin 700; or equal.

4. Provide relays with the number of contacts shown on the schematic diagrams. Utilize additional contact blocks or relays to satisfy the number of contacts shown at no additional cost to the Owner. Plug-in relays are acceptable and shall have retaining clips.

G. Miscellaneous Devices

1. Control switches shall be round, oiltight type, complete with legend plates and quantity of contact blocks required for the control function.

2. Indicating lights shall be oiltight type, complete with color of lens indicated in drawings and legend plate. Indicating lights shall be push-to-test type.

3. Elapsed time meters shall be synchronous motor driven, 0- to 99,999.9-hour range, nonreset type, suitable for semiflush panel mounting.

H. EMI/RFI Interference Suppression

1. The VFD shall fulfill all electromagnetic compatibility immunity requirements per the following standards utilizing input and output EMI/RFI filters. These filters shall suppress all objectionable interference to AM and FM radio signals in the immediate vicinity of the facility.

   a. IEC 61800-2 and –3.

   b. EN 50082-1 and –2.

   c. EN 61000-6-1, -6-2, and –6-4.

   d. EN 61800-3+A11.

2. Declaration of Conformity: The Manufacturer’s Declarations of Conformity assuring the compliance of the proposed drives with the above standards shall be made available upon request.

I. Harmonic Suppression Equipment and Output Filters

1. VFDs shall meet requirements outlined in the current edition of IEEE 519 for each individual and total harmonic current distortion and as indicated in these specifications, whichever is

more stringent. Total demand distortion (TDD) as defined by IEEE 519, caused by the simultaneous operation of the VFDs shall not exceed 5% at the main service while operating from the utility source. Provide additional harmonic filters, if required, to meet these requirements.

2. Submit a harmonic analysis showing compliance with the above requirement including all voltages and current harmonics up to the 49th.

3. Base harmonic analysis of the system operating from the utility source on a short-circuit kva available at the main switchboard of 42,000 kva.

4. Output filters shall also protect motor bearings from damage due to currents that may flow in the bearings created by shaft voltages imposed by the VFD controller. Coordinate with motor manufacturer to determine the appropriate filters required.

J. Factory Testing

1. Subject the VFDs to a complete functionality test and a full-load operational test prior to shipment. Simulate remote inputs and outputs and verify correct operation. Submit certified factory test report.

2. Set adjustable set points of the drives at motor manufacturer's recommended values. Coordinate with motor manufacturer and obtain recommended set point values in writing. Document information in O&M manual.

K. Spare Parts

Provide six spare fuses of each type and ampere rating installed. Provide two of each type of converter power semiconductor, two of each type of inverter power semiconductor, one keypad assembly, five of each type of panel lamps, and one of each type of control printed circuit board and gate firing boards. Pack spare parts in a wooden box; label with manufacturer's name and representative's name, address, and telephone number; and attach list of material contained within.

PART 3 - EXECUTION

A. Installation

Secure drives rigidly to walls and floors or mounting pads with anchor bolts or concrete anchors. Anchor bolts or concrete anchors shall be 316 stainless steel. Installation shall be in accordance with manufacturer's installation instructions and Section 260548.

B. Field Tests

1. Provide the services of a qualified factory-trained manufacturer's representative to assist in testing and start-up of the equipment specified under this section, in accordance with manufacturer's published start-up services. Additionally, perform the following minimum work under the technical direction of the manufacturer's service representative if not included in their published start-up services:

   a. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus. Exclude such tests harmful to electronic components.

b. Torque all bolted connections made in the field and verify all factory-bolted connections.

c. Verify that factory-set adjustable set points of VFD are in accordance with the motor manufacturer's recommendations.

d. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations. Drive and motor nameplate information, settings, and operating parameters shall be documented. Equipment shall be inspected prior to the generation of any reports.

2. Adjust control set points and verify proper operation. Coordinate minimum speed with performance requirements of driven equipment.

3. Test the operation of each interlock to verify that the interlock performs its function.

4. Test the operation of each control feature to verify operation of the controls.

5. Perform dynamic tuning tests with the facility controls.

6. Measure total harmonic distortion with all drives (excluding the backup units) operating at 100% speed for compliance with harmonic design requirements. Utilize a recording-type harmonic analyzer displaying individual and total harmonic currents and voltages up to the 49th harmonic. Test shall be performed by the manufacturer's authorized representative or a NETA-certified independent testing company.

END OF SECTION

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SECTION 331300 DISINFECTION OF PIPING AND STRUCTURES

PART 1 - GENERAL

A. Description

This section includes materials and procedures for disinfection of water mains and GAC vessels by the continuous feed method and by the slug method. Disinfect piping in accordance with AWWA C651, except as modified below.

B. Related Work Described Elsewhere

Pressure Testing of Piping: 400515.

C. Job Conditions

1. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility.

2. Use potable water for chlorination.

PART 2 - MATERIALS

A. Liquid Chlorine

Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.

B. Calcium Hypochlorite (Dry)

Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate.

C. Sodium Hypochlorite (Solution)

Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

D. Chlorine Residual Test Kit

For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per AWWA C651, Appendix A.1. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

A. Continuous Feed Method for Pipelines

Introduce potable water into the pipeline and GAC vessels at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline and GAC vessels is maintained at a minimum concentration

of 50 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

B. Slug Method for Pipelines

Introduce the water in the pipeline at a constant measured rate. At the start of the test section, feed the chlorine solution into the pipeline at a measured rate so that the chlorine concentration created in the pipeline is 300 mg/L. Feed the chlorine for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/L for at least three hours.

C. Disinfection of Valves, Blind Flanges, and Appurtenances

During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1% sodium hypochlorite solution.

D. Disinfection of Connections to Existing Pipelines

Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1% sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

E. Disinfection of GAC Vessels

GAC vessels shall be disinfected in accordance with AWWA C653.

F. Confirmation of Residual in Piping

1. After the chlorine solution applied by the continuous feed method has been retained in the pipeline and GAC vessels for 24 hours, confirm that a chlorine residual of 50 mg/L minimum exists along the pipeline by sampling at air valves and other points of access.

2. With the slug method, confirm by sampling as the slug passes each access point and as it leaves the pipeline and that the chlorine concentration in the slug is at least 50 mg/L.

3. If the water temperature is less than 41°F, the chlorine residual of 50 mg/L minimum shall be maintained for 48 hours.

G. Pipeline Flushing

After confirming the chlorine residual, flush the excess chlorine solution from the pipeline and GAC vessels until the chlorine concentration in the water leaving the pipe is no higher than that generally prevailing in the distribution system.

H. Sampling and Bacteriologic Testing

1. There shall be no water in trenches up to the connection for sampling. The sampling piping shall be clean, disinfected, and flushed prior to sampling.

2. Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline

after chlorination and refilling. Collect at least one set of samples from the new water mains upstream of the GAC vessels plus one set from downstream of the GAC vessels. At each connection to an existing pipeline, take two additional samples. Use pipeline dedicated sampling ports for obtaining samples.

I. Piping Test Facility Removal

After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

J. Piping to be Disinfected

Disinfect all piping except drainage piping and storm drain piping.

K. Repetition of Procedure

If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

END OF SECTION

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SECTION 332134 WELL DISINFECTION

PART 1 - GENERAL

A. Description

This section includes supplying the specified disinfectant to the well and pumping until the chlorine residual is less than the maximum concentration specified.

PART 2 - MATERIALS

A. Disinfectant

The disinfectant shall be liquid chlorine, sodium hypochlorite, or calcium hypochlorite in granular form or in small tablets.

PART 3 - EXECUTION

A. Disinfecting

1. To disinfect the well, move a doubly capped, perforated pipe container filled with the granular chlorine compound up and down the entire water-filled casing and screen section until the chlorine compound has dissolved.

2. Install the permanent pump and pumping equipment. Alternately start and stop the pump to gently surge the well and force chlorine solution into the aquifer. Allow the well to stand for 24 hours without pumping. At the end of the 24-hour period, pump the well to waste at a rate to be determined by the Owner's Representative until no detectable chlorine residual remains. Continue pumping thereafter for a minimum of 15 minutes, at which time the Owner's Representative will conduct bacteriological sampling. A minimum of two water samples shall be taken not less than 30 minutes apart while the well is being continuously pumped. Then redisinfect the well with liquid sodium hypochlorite at the option of the Owner's Representative and repeat the pumping and sampling.

B. Eliminating Chlorine Residual

Eliminate the chlorine residual before the water reaches the point of disposal. Use chemicals listed in the appendix of AWWA C601.

END OF SECTION

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SECTION 333112 PVC GRAVITY DRAIN PIPE

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of PVC gravity drain pipe conforming to ASTM D3034 or ASTM F679. Sizes are 4 through 15 inches for ASTM D3034 pipe and 18 through 27 for ASTM F679 pipe.

B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 312316.

2. Leakage and Infiltration Testing: 330130.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit reports on testing per ASTM D3034 (pipes 3 inches through 15 inches), ASTM F679 (pipes 18 through 27 inches).

PART 2 - MATERIALS

A. PVC Material

Additives and fillers, including stabilizers, antioxidants, lubricants, colorants, etc., shall not exceed 10 parts by weight per 100 of PVC resin in the compound.

B. Pipe

1. Pipe 4 through 15 inches shall conform to ASTM D3034, SDR 35.

2. Pipe 18 through 27 inches shall conform to ASTM F679, Pipe Stiffness Class PS-115.

C. Joints

Provide elastomeric gasket joints of the push-on type, conforming to ASTM D3212.

D. Gaskets

Gaskets for push-on joints shall conform to ASTM F477.

E. Fittings

1. Fittings for pipe 4 through 15 inches shall conform to ASTM D3034, SDR 35.

2. Fittings for pipe 18 through 27 inches shall be fabricated of the same material as the pipe and shall comply with ASTM F679.

F. Mandrel for Field Testing of Pipe Deflection

The mandrel shall:

1. Be a rigid, nonadjustable, odd-numbering-leg (nine legs minimum) mandrel having an effective length not less than its nominal diameter.

2. Have a minimum diameter at any point along the full length as follows:

Pipe Material	Nominal Size (inches)	Minimum Mandrel Diameter (inches)
PVC-ASTM D3034 (SDR 35)	6	5.619
	8	7.524
	10	9.405
	12	11.191
	15	13.849
PVC-ASTM F679 (T-1 Wall)	18	16.924
	21	19.952
	24	22.446
	27	25.297

3. Be fabricated of steel; be fitted with pulling rings at each end; be stamped or engraved on some segment other than a runner indicating the pipe material specification, nominal size, and mandrel outside diameter (e.g., PVC, D 3034-8"-7.524"); and be furnished in a carrying case labeled with the same data as stamped or engraved on the mandrel.

4. All costs incurred by the Contractor attributable to mandrel and deflection testing, including any delays, shall be borne by the Contractor at no cost to the Owner.

PART 3 - EXECUTION

A. Installing PVC DRAIN Pipe

1. Install in accordance with Section 312316, ASTM D2321, and as described below.

2. Pipe shall not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.

3. Minimum bedding thickness shall be as specified in Section 312316.

4. Lay pipe without break, upgrade from structure to structure, with the socket ends of the pipe upgrade.

5. Do not use the pipe as a drain for removing water that has infiltrated into the trench.

6. After joint assembly, bring the bedding material up to pipe spring line. Bedding material shall be imported sand per Section 312316. Place the bedding material on each side of the pipe. Tamp the bedding material into final position at pipe spring line and continue to the top of the pipe. Relative compaction shall be in conformance with Section 312316.

7. Then place bedding material to 1 foot above the top of the pipe and compact to the same relative compaction as in the pipe zone per Section 312316. The remainder of the trench backfill shall be native material, installed per Section 312316.

8. Do not use hydro-hammers to compact bedding or backfill.

B. Installing Pipe at Manholes and Structures

1. Place a 2-foot PVC length of pipe of the same inside diameter as the adjoining pipe at the inlet and outlet to each manhole or structure. Use one of the following methods:

   a. Directly cast a manhole coupling into the manhole base. Provide rubber-ring gasket in the coupling.

   b. Stretch a rubber-ring gasket around the pipe to serve as a water stop when cast into the structure wall.

2. Do not cast pipe bells into manholes or structures. Cut off the bell so that no recess or offset appears on the exposed face from the inside wall of the pipe to the outside wall of the pipe. The pipe shall have a plain end, flush with the inside wall of the manhole or structure, or as shown in the drawings.

C. Testing for Defects of Installed Pipe

Following placement and compaction of backfill and prior to placing permanent pavement, ball and mandrel the pipe to measure for obstructions (excessive deflections, joint offsets, and lateral pipe intrusions).

D. Field Testing for Pipe Deflection

1. Test installed pipe to ensure that vertical deflections for plastic pipe do not exceed the maximum allowable deflection. Maximum allowable deflections shall be governed by the mandrel requirements stated herein and shall nominally be:

Nominal Pipe Size	Percentage
Up to and including 12 inches	5.0
Over 12 to and including 27 inches	4.0

2. The maximum average inside diameter shall be equal to the average outside diameter per applicable ASTM standard minus two minimum wall thicknesses per applicable ASTM standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

3. Perform deflection tests not sooner than 30 days after completion of placement and compaction of backfill. Clean and inspect the pipe for offsets and obstructions prior to testing.

4. Pull a mandrel through the pipe by hand to verify that maximum allowable deflections have not been exceeded. Prior to use, the mandrel shall be certified by an independent testing laboratory. Use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate test. If the mandrel fails to pass, the pipe will be deemed to be overdeflected.

5. Uncover any overdeflected pipe and, if not damaged, reinstall. Remove damaged pipe from the site. Any pipe subjected to any method or process other than removal, which attempts,

even successfully, to reduce or cure any overdeflection, shall be uncovered, removed from the site, and replaced with new pipe.

E. Leakage Test

See Section 330130.

END OF SECTION

SECTION 400500 GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

A. Description

This section describes the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

B. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).

3. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

4. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

C. Definitions of Buried and Exposed Piping

1. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure. Where a coating is specified, provide the coating up to the structure wall. Unless detailed otherwise, coating shall penetrate wall no less than 1 inch. Piping encased in concrete is considered to be buried. Do not coat encased pipe.

2. Exposed piping is piping in any of the following conditions or locations:

   a. Above ground.

   b. Inside buildings, vaults, or other structures.

   c. In underground concrete trenches or galleries.

D. Piping Service

Piping service is determined by the fluid conveyed, regardless of the pipe designation. For example, pipes designated "Air Low Pressure," "Air High Pressure," and "Air" are all considered to be in air service.

PART 2 - MATERIALS

A. Materials Selection and Alternative Materials

The drawings may show alternative piping materials for certain services. In such cases, the same pipe material shall be used for all pipe sizes in all locations for the given piping service. Do not intermix piping materials.

B. Thread Forming for Stainless Steel Bolts

Form threads by means of rolling, not cutting or grinding.

C. Bolts and Nuts for Flanges for Steel and Ductile-Iron Piping

1. Bolts and nuts for Class 125 or 150 flanges (including AWWA C207, Class D) located indoors, outdoors above ground, and in vaults and structures shall be carbon steel, ASTM A307, Grade B, hot-dipped galvanized per ASTM F2329.

2. Bolts and nuts for buried or submerged Class 125 or 150 flanges shall be 316 or 316L stainless steel with strength equivalent to carbon steel bolts and nuts (AWWA C207).

3. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

4. Provide washers for each nut. Washers shall be of the same material as the nuts.

D. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Husky™ Lube O'Seal, or equal.

E. Gaskets for Flanges for Steel Piping in Water Service

1. Gaskets shall be NSF-61 certified for potable water service.

2. Gaskets for flat face and raised face flanges shall be 1/16-inch for pipes 6 inches in diameter and smaller or 1/8-inch thick for larger pipes and shall be one of the following nonasbestos materials:

   a. Aramid fiber-inserted rubber gaskets. Gaskets shall be suitable for a pressure of 200 psi at a temperature of 180°F. Products: Garlock Multi-Swell 3760-U or equal.

   b. PTFE with inert filler, 1/8 inch thick. Gaskets shall be suitable for a pressure of 500 psi at a temperature of 400°F. Products: Garlock Gylon Style 3505 or equal.

F. Gaskets for Flanges for Ductile-Iron Piping and Fittings in Water Service

1. Gaskets shall be NSF-61 certified for potable water service.

2. Gaskets shall be full face, 1/8-inch thick, aramid fiber-inserted rubber. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Multi-Swell Style 3760-U or equal.

G. Gaskets for Flanges for PVC and CPVC Piping

1. Nonpotable service. Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material for other than sodium hypochlorite service shall be EPR. Gasket material for sodium hypochlorite service shall be Viton ETP.

2. Potable service. Gaskets for flanged joints shall be full faced and have a hardness of 70 durometer A. Gaskets shall be NSF-61 certified Garlock Stress Saver XP or equal.

PART 3 - EXECUTION

A. Raised Face and Flat Face Flanges

Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

B. Installing Aboveground or Exposed Piping

1. Provide pipe hangers and supports as detailed in the drawings.

2. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

C. Installing Flanged Piping

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

D. Installing Blind Flanges

1. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.

2. Coat the inside face of blind flanges per Section 099000, System No. 7.

E. Installing Grooved-End Piping

1. Install grooved-end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following.

2. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove before installing coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.

3. Fasten coupling alternately and evenly until coupling halves are seated. Use torques as recommended by the coupling manufacturer.

4. Provide separate hangers and supports at both sides of flexible joints.

F. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

SECTION 400515 PRESSURE TESTING OF PIPING

PART 1 - GENERAL

A. Description

This section specifies the hydrostatic and leakage testing of pressure piping for pumping stations, GAC vessels, and water distribution and transmission mains.

B. Related Work Specified Elsewhere

1. Disinfection of Piping: 331300.

2. Manual, Check, and Process Valves: 400520.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

3. Submit six copies of the test records to the Owner's Representative upon completion of the testing.

D. Test Pressures

Test pressures for the various services and types of piping are shown in the subsection on “Test Pressure and Test Fluids” in Part 3.

E. Testing Records

Provide records of each piping installation during the testing. These records shall include:

1. Date and times of test.

2. Identification of pipeline or pipeline section tested or retested.

3. Test fluid.

4. Test pressure.

5. Remarks: Leaks identified (type and location), types of repairs, or corrections made.

6. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 - MATERIALS

A. Testing Fluid

1. Testing fluid shall be water.

2. For potable water pipelines, obtain and use only potable water for hydrostatic testing.

3. Submit request for use of water from waterlines of Owner 48 hours in advance.

4. The Contractor may obtain the water from the Owner at no charge.

B. Testing Equipment

Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic testing.

PART 3 - EXECUTION

A. Testing Preparation

1. Pipes shall be in place, backfilled, and anchored before commencing pressure testing.

2. Conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.

3. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. Perform the final pressure test, however, after completely backfilling and compacting the trench.

4. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.

5. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Drain the pipes after they have been tested.

6. Prior to starting the test, the Contractor shall notify the Owner's Representative.

B. Cleaning

Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. Maintain a flushing velocity of at least 3 fps for water testing. Flush pipes for time period as given by the formula

$$T = \frac{2L}{3}$$

in which: T = flushing time (seconds)
L = pipe length (feet)

C. Testing and Disinfection Sequence for Potable Water Piping

1. Perform required disinfection after hydrostatic testing, except when pipeline being tested is connected to a potable waterline.

2. Locate and install test bulkheads, valves, connections to existing pipelines, and other appurtenances in a manner to provide an air gap separation between existing potable water pipelines and the pipeline being tested. Disinfect water and pipeline being tested before hydrostatic testing when connected to a potable waterline.

D. Initial Pipeline Filling for Hydrostatic Testing

Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

E. Testing New Pipe Which Connects to Existing Pipe

Prior to testing new pipelines that are to be connected to existing pipelines, isolate the new line from the existing line by means of test bulkheads, spectacle flanges, or blind flanges. After successfully testing the new line, remove test bulkheads or flanges and connect to the existing piping.

F. Hydrostatic Testing of Aboveground or Exposed Piping

1. Open vents at high points of the piping system to purge air while filling the pipe with water. Venting during system filling may also be provided by temporarily loosening flanges.

2. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

G. Hydrostatic Testing of GAC Vessels

Isolate GAC vessels from connecting pipelines and test to 90 psi for a minimum of 4 hours. Following testing, dewater GAC vessels, open manways, and allow vessels to air dry for 48 hours, after which time the interior coatings will be inspected by the manufacturer. Repairs, if necessary, will be conducted by the manufacturer. Following the repairs, secure the manways and conduct the disinfection procedures prior to loading the carbon.

H. Hydrostatic Testing of Buried Piping and Chemical Feed Tubing

1. Where any section of the piping contains concrete thrust blocks or encasement, do not perform the pressure test until at least 10 days after placing the concrete. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

2. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.

3. Maintain the test pressure for the duration of the test and restore it whenever it falls an amount of 5 psi.

Pipe Diameter (inches)	Hours
18 and less	4
20 to 36	8
Greater than 36	24

4. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula:

$$L = \frac{HND(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons)
H = specified test period (hours)
N = number of rubber-gasketed joints in the pipe tested
D = diameter of the pipe (inches)
P = specified test pressure (psig)
C = 7,400

5. Test pressure and duration shall be as defined by the Owner. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

6. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

I. Repetition of Test

If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

J. Bulkhead and Test Facility Removal

After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

K. Test Pressure and Test Fluids- Above Ground Piping

Testing and design pressures (psig) shall be as listed below:

Pipe Service	Pipe Material	Testing Fluid	Design Pressure	Test Pressure
GAC vessels		Potable water	70	90
Water	WSP/DIP/GSP	Potable water	70	105
Chemical feed	PE, PVC	Potable water	70	105

END OF SECTION

SECTION 400520 MANUAL, CHECK, AND PROCESS VALVES

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of manually operated valves, check valves, and process valves including gate, butterfly, ball, hose bibbs, globe, angle, check, solenoid, vacuum breakers, and instrument valve manifolds.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.

2. Piping Schedule and General Piping Requirements: 400500.

3. Pressure Testing of Piping: 400515.

4. Equipment, Piping, Duct, and Valve Identification: 400775.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

3. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

4. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

5. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."

6. For butterfly and eccentric plug valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.

PART 2 - MATERIALS

A. General

1. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

2. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

3. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

4. All valves that will may into contact with potable water shall be certified to NSF/ANSI 61 Drinking Water Systems – Health Effects and certified to be lead free in accordance with NSF/ANSI 61, Annex G.

B. Valve Actuators

1. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

2. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 5 feet 9 inches above the floor, provide chainwheel and guide actuators.

3. Provide 2-inch AWWA operating nuts for buried and submerged valves.

4. Provide enclosed gear actuators on butterfly, ball, and plug valves 8 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators for valves 8 through 20 inches shall be of the worm and gear, or of the traveling nut type. Gear actuators for valves 24 inches and larger shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.

5. Design gear actuators assuming that the differential pressure across the plug, gate, or disc is equal to the test pressure of the connecting piping and assuming a fluid velocity of 16 fps for valves in liquid service and 80 fps for valves in air or gas service and a line fluid temperature range of 33°F to 125°F unless otherwise required in the detailed valve specifications. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.

6. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

7. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 40 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

8. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

9. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B84, Alloy C86200), accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148, Grade 105-85), with thread ground and polished. Support worm-gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

10. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

11. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

C. Chainwheels and Guides

Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal. Chainwheels and guides shall be galvanized iron or steel or aluminum. Chains shall extend to within 4 feet of the operating floor. Chains shall be galvanized steel.

D. Valve Tagging and Identification

Provide identifying valve tags per Section 400775.

E. Bolts and Nuts for Flanged Valves

Bolts and nuts for flanged valves shall be as described in Section 400500.

F. Gaskets for Flanges

Gaskets for flanged end valves shall be as described in Section 400500.

G. Painting and Coating

1. Coat metal valves located above ground or in vaults and structures in accordance with Section 099000. Apply the specified prime, intermediate and finish coats at the place of manufacture. Coat handwheels the same as the valves.

2. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 099000, System No. 7. Apply lining at the place of manufacture.

3. Coat floor stands per Section 099000, System No. 15.

4. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

5. Measure the thickness of the valve interior linings per Section 099000. Repair areas having insufficient film thickness per Section 099000.

H. Packing, O-Rings, and Gaskets

Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

1. Teflon.

2. Kevlar aramid fiber.

3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

4. Buna-N (nitrile).

I. Rubber Seats

Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

J. Valves

1. Gate Valves:

a. Aboveground Bronze Gate Valves 3 Inches and Smaller (Low Lead):

Aboveground threaded end or solder end gate valves, 1/4 through 3 inches, for water service shall be rising stem, screwed bonnet, solid wedge disc type, Class 200, having a minimum working pressure of 200 psi CWP at a temperature of 150°F and conforming to MSS SP-80. Materials of construction shall be as follows:

Component	Material	Specification
Body and bonnet, wedge	Bronze	ASTM B584, Alloy C87850, C89833, or C89836
Stem	Bronze or copper silicon	ASTM B99 (Alloy 651), B584 (Alloy C87600), B371 (Alloy C69400 or C69700)

Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above.

Handwheels shall be aluminum, brass, or malleable iron. Packing shall be Teflon or Kevlar aramid fiber. Valves shall be Nibco T-113-LF or S-113-LF or equal.

b. Ductile-Iron Resilient Wedge Gate Valves 4 Through 36 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum or more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of

10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Waterous, Kennedy, or equal.

2. Butterfly Valves:

a. Thrust Bearings for Butterfly Valves:

Provide thrust bearings to hold the valve disc in the center of the valve seat. No bearings shall be mounted inside the valve body within the waterway. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

b. Bronze Components in Butterfly Valves:

Bronze components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	0.20% maximum
Copper + Nickel + Silicon	83% minimum

c. Port Sizes for Butterfly Valves:

For valves 24 inches and smaller, the actual port diameter shall be at least 93% of the nominal valve size. For valves larger than 24 inches, the port diameter shall not be more than 1.25 inches smaller than the nominal valve size. The dimension of the port diameter shall be the clear waterway diameter plus the thickness of the rubber seat.

d. Corrosion-Resistant Materials in Butterfly Valves:

Where AWWA C504 requires “corrosion resistant” material, such material shall be one of the following:

(1) Bronze as described above.

(2) Type 304 or 316 stainless steel.

(3) Monel (UNS N04400).

(4) Synthetic nonmetallic material.

e. Seating Surfaces in Butterfly Valves:

Seating surfaces in valves having motorized actuators shall be stainless steel or nickel-copper per AWWA C504 or nickel-chromium alloy containing a minimum of 72% nickel and a minimum of 14% chromium.

f. Factory Leakage Testing:

Perform factory leakage tests per AWWA C504 on both sides of the seat.

g. Type 200--Flanged, Rubber-Seated Butterfly Valves 4 Through 72 Inches, Class 150B:

Butterfly valves shall be short body, flanged type for exposed valves and valves in vaults or structures, and either flanged or mechanical joint for buried valves. Valve shall conform to AWWA C504, Class 150B. Minimum working differential pressure across the valve disc shall be 150 psi. Flanged ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	Ductile iron	AWWA C504
Exposed body cap screws and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Discs	Cast iron, ductile iron, Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N	—

Where the rubber seat is applied to the disc, it shall be bonded to a stainless steel seat retaining ring which is clamped to the disc by Type 304 or 316 stainless steel screw fasteners or secured to a stainless steel seat by a combination of cap screws, a serrated disc retaining ring, and molded shoulders in the seat mating with machined registers in the disc. Alternatively, the rubber valve seat shall be secured to or retained in the valve body. Valves shall be Pratt, DeZurik Series BAW, M&H, Val-Matic, or equal.

h. Type 230-Lug-Type Rubber-Seated Cast Steel Butterfly Valves 2 Through 12 Inches, Class 150:

Butterfly valves shall be of the lug type, faced, drilled, and tapped for ASME B16.5 and ASME B16.47 (Series A) Class 150, flat and raised face flange connections. Valve design, construction, and testing shall comply with MSS SP-61 and either MSS SP-67 or MSS SP-68. Leakage shall comply with FCI 70-2 (ASME B16.104), Class VI. Valve shall provide bubble-tight shutoff for bidirectional deadend service. Minimum shutoff pressure shall be 285 psig at 100°F. Valve shaft shall be a one-piece unit in continuous contact through the disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	Carbon steel	ASTM A216 or A516
Shaft and taper pins	Stainless steel	ASTM A564, Alloy S17400, or AISI Type 316
Shaft bearings	Stainless steel reinforced Teflon	AISI Type 316
Disc	stainless steel	ASTM A351, Grade CF8M
Packing	Teflon	—
Packing follower, nuts and studs, and seat retainer	Stainless steel	AISI Type 316

Valve seat shall be mounted in the body and made of Teflon with titanium backup ring or Viton or silicon rubber O-ring encased in Teflon. Coat carbon steel bodies (exterior) per Section 099000, System No. 7, or equal. Valve shall be DeZurik BHP, Bray/McCannalok Series 41, or equal.

i. Type 260—Wafer Style, Rubber-Seated Butterfly Valves 2 Through 12 Inches, Class 200:

Valves shall have a resilient seat mounted in the body with replaceable O-ring flange seals. The seat lining shall extend across the entire length of the body. Body design shall be of the wafer type for installation between two ASME B16.5, Class 150 flanges or two ASME B16.1, Class 125 cast-iron flanges. Materials of construction shall be as follows:

Component	Material	Specification
Body	Ductile iron	ASTM A395, Grade 60-40-18
Disc	Stainless steel	ASTM A743, Grade CF8M
	Aluminum bronze	ASTM B148, Alloy C95400
Shaft	Stainless steel	ASTM A276, Type 316
Seat	EPDM or Buna-N	—
O-rings	EPDM or Buna-N	—

Pressure rating shall be at least 200 psi at a temperature of -30°F to +250°F. Valves manufacturers shall be DeZurik, Watts, Norris or equal.

3. Ball Valves:

a. Type 301 Full Port Threaded Bronze Ball Valves 2 Inches and Smaller (Low Lead):

Ball valves, 2 inches and smaller, for water service shall have a pressure rating of at least 600 psi WOG at a temperature of 100°F. Provide full port ball and body design. Valves shall comply with MSS SP-110. Materials of construction shall be as follows:

Component	Material	Specification
Body	Bronze	ASTM B584, Alloy C89836
Ball	Bronze	ASTM B584, Alloy C89836 or Alloy C27450, chromium plated
Ball retainer	Bronze	ASTM B584, Alloy C89836 or ASTM B371, Alloy C69430
Stem	Bronze	Alloy C27450
Seats	Reinforced Teflon	—

Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Valves shall have threaded ends (ASME B1.20.1), nonblowout stems, and have plastic-coated lever actuators. Provide locking lever handle. Valves shall be Apollo 77CLF Series or equal.

b. Type 302 Nut-and-Ferrule Brass Ball Valves (Straight Pattern), 3/4 Inch and Smaller:

Brass ball valves, 3/4 inch and smaller, for water service shall be straight pattern and rated at a minimum pressure of 2,500 psi at a temperature of 150°F. Adjust valves for an operating pressure of 1,000 psi at a temperature of 70°F. Valve body, ball, stem, side rings, disc rings, and packing bolt shall be brass. Upper and lower packing shall be Teflon. Provide lever actuators with plastic handle. Provide end connections of the nut-and-ferrule type for connection to tubing. Products: Whitey Series 40 or equal.

c. Type 308 Bronze Ball/Corporation Stops, 2 Inches and Smaller, for Water Service:

Corporation stops shall be bronze with male inlet iron pipe threads and female outlet iron pipe threads and shall conform to AWWA C800. Components in contact with water shall be low-lead bronze (ASTM B584, Alloys C89833 or C89836). Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Minimum pressure rating shall be 300 psi. Stops shall be Ford Ballcorp Type FB 1700, James Jones J-1931, or equal.

d. Type 310 Double Union PVC Ball Valves 3 Inches and Smaller:

Thermoplastic ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be EPDM. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VK or VKD, or equal.

e. Type 316 Double Union CPVC Ball Valves 3 Inches and Smaller with Vented Ball for Sodium Hypochlorite Service:

Vented CPVC ball valves, 3 inches and smaller, for chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 85 psi at a temperature of 140°F. Provide machined vent hole, deburred, in the ball to allow gases to vent. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of

the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be Plast-O-Matic "Z-MBV-Vent," Asahi/America Type 21, or equal.

f. Type 322 Nut-and-Ferrule Stainless Steel Ball Valves (Straight Pattern), 3/4 Inch and Smaller:

Stainless steel ball valves, 3/4 inch and smaller, for water and chemical service shall be straight pattern and rated at a minimum pressure of 2,500 psi at a temperature of 150°F. Adjust valves for an operating pressure of 1,000 psi at a temperature of 70°F. Valve body, ball, stem, side rings, disc rings, and packing bolt shall be Type 316 stainless steel (ASTM A276, A351, or A479). Upper and lower packing shall be Teflon. Provide lever actuators with plastic handle. Provide end connections of the nut-and-ferrule type for connection to tubing. Products: Whitey Series 40 or equal.

4. Globe Valves, Angle Valves, Hose Valves, Hose Bibbs, and Fire Hydrants:

a. Bronze Globe Valves 2 Inches and Smaller:

Globe valves, 2 inches and smaller, shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with screwed ends, union bonnet, inside screw, rising stem, and composition or PTFE disc. Valves shall have a pressure rating of at least 300 psi at a temperature of 150°F. Stem shall be bronze: ASTM B371 (Alloy C69400), ASTM B99 (Alloy C65100), or ASTM B584 (Alloy C87600). Valves shall be Crane No. 7TF, Walworth Figure 3095, Stockham B-22T, or equal.

b. Bronze Angle Hose Valves (1-1/2 and 2-1/2 inches):

Angle-type hose valves of sizes 1-1/2 and 2-1/2 inches shall be brass or bronze (ASTM B62 or ASTM B584, Alloy C83600) body with rising or nonrising stem, composition disc, and bronze or malleable iron handwheel. Stem shall be bronze, ASTM B62 or ASTM B584 (Alloy C83600). Valves shall have a cold-water service pressure rating of at least 150 psi. Provide cap and chain with valve. Threads on the valve outlet shall be American National Standard fire hose coupling screw thread. Valves shall be Powell Figure 151 with Figure 527 nipple adapter, Crane 17TF with hose nipple adapter, or equal.

c. Bronze Hose Bibbs:

Hose bibbs of size 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or nonrising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be Teflon or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlet shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Provide atmospheric vacuum breaker conforming to ASSE Standard 1011 and IAPMO code and approved by the City of Livingston. Valves shall be Jenkins Figure 112, 113, or 372; Nibco Figure T-113-HC; or equal

d. Bronze Needle Valves 3/4 Inch and Smaller:

Needle valves shall be all bronze (ASTM B61, ASTM B62, or ASTM B584, Alloy C83600) with screwed ends, screwed bonnet, and rising stem. Valves shall have a pressure rating of at least 400 psi at a temperature of 150°F. Stem shall be bronze:

ASTM B98 (Alloy C65100), ASTM B150 (Alloy C64200), ASTM B584 (Alloy C87600), or ASTM B371 (Alloy C69400). Valves shall be Stockham B-64, Crane No. 88, or equal.

5. Solenoid Valves:

   a. Design and construct solenoid valves such that they can be used in both horizontal and vertical piping.

   b. Metallic Solenoid Valves 1-1/2 Inches and Smaller:

      Solenoid valves of sizes 1/4 through 1-1/2 inches for water and air service shall have forged brass (Alloy C23000) or bronze (ASTM B62) bodies with Teflon main seats. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel (Types 302, 304, or 305). Solenoid enclosures shall be NEMA 4. Valve actuators shall be 120-volt a-c. Seals shall be Teflon. Valves shall have a maximum operating pressure and a maximum differential pressure of 300 psi. Valves shall be energized to open. Valves shall be ASCO "Redhat", Parker Hannifin “Skinner”, or equal.

6. Pet Cocks and Drain Cocks:

   a. Type 1000--Pet Cocks 1/2 Inch and Smaller:

      Pet cocks shall be all bronze (ASTM B62) or brass (ASTM B16), rated at 125 psi. Provide lever or tee handle operator. Pet cocks shall be Crane Figure 724, Lunkenheimer Figure 478 or 479, or equal.

   b. Drain Cocks 1/2 Inch and Smaller:

      Drain cocks shall be all bronze (ASTM B62) or brass (ASTM B16), rated at 125 psi. Provide lever or tee handle operator. Drain cocks shall be Crane Figure 702, Lunkenheimer Figure 476 or 980, or equal.

7. Vacuum Breakers:

   a. Atmospheric Vacuum Breakers:

      Vacuum breaker valves shall allow air to enter the line in the event pressure loss causes vacuum conditions. The air inlet shall close without spillage upon initial application of line pressure. The body shall be brass UNS C46400. Poppet or ball shall be plastic suitable for service in water or AISI Type 440 stainless steel. Seat shall be Buna-N. Valves shall be Febco Model 710, Johnson Corporation Series VBB, Wilkins Division of Zurn Industries, or equal.

PART 3 - EXECUTION

A. Valve Shipment and Storage

1. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at the place of valve manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures. Alternatively, ship flanged valves 3 inches and smaller in separate sealed cartons or boxes.

2. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping. Alternatively, ship valves having threaded openings or end connections in separate sealed cartons or boxes.

3. Store resilient seated valves in sealed polyethylene plastic enclosures with a minimum of one package of desiccant inside. Store resilient seated valves in the open or unseated position. Valves with adjustable packing glands shall have the packing gland loosened prior to storage. Inspect valves at least once per week, replace desiccant if required and repair damaged storage enclosures. Do not store valves with resilient seats near electric motors or other electrical equipment.

4. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around operating shaft, actuator, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.

5. Protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.

6. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the actuator to the valve for loosening in transit and handling. If loose, tighten firmly. Open and close valves having manual or power actuators to make sure the valve operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close valve before installing.

B. Factory Pressure Testing

1. Hydrostatically test the valve pressure-containing parts at the factory per the valve specification or per the referenced standard. If no testing requirement is otherwise specified or described in the referenced standards, then test with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, then provide an additional operational test and verify that the valve components function.

2. The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 ppm. To prevent deposition of chlorides as a result of evaporative drying, remove residual liquid from tested parts at the conclusion of the test.

C. Installing Valves—General

1. Remove covers over flanged openings and plugs from threaded openings, after valves have been placed at the point to which the valves will be connected to the adjacent piping. Do not remove valves from storage cartons or boxes until they are ready to be installed.

2. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault or building walls, or trench walls.

3. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a

valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

4. Make sure valve ends and seats are clean. Check exposed bolting for loosening in transit and handling and tighten to manufacturer's recommendations. Open and close the valve to make sure it operates properly and that stops or limit switches are correctly set so that the vane, ball, gate, needle, diaphragm, disc, plug, or other seating element seats fully. Close the valve before installing. Check coatings for damage and repair. Handle valves carefully when positioning, avoiding contact or impact with other equipment or structures.

5. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

D. Installing Exposed Valves

1. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

2. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

E. Installing Buried Valves

1. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement, and place and compact the backfill to the height of the valve stem.

2. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.

3. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.

4. In streets without concrete curbs and in open areas, install the valve box as for a paved area with concrete curb except include a marker post. Cut the marker post from 4-inch by 4-inch dense structural grade Douglas fir No. 2 or Southern Pine No. 2 surfaced on four sides to a length of 5 feet. Chamfer the top. Set the post in concrete, 2 feet into the ground, away from traffic, and to the side of the pipeline. Coat with a seal and finish coat of white alkyd exterior paint. On the side facing the valve, letter in black the word "VALVE" and the distance in feet from the marker post to the valve box cap.

F. Field Coating Buried Valves

1. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 099000, System No. 24.

2. Wrap buried metal valves with polyethylene sheet per Section 099754.

G. Assembling Joints

1. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and

graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

4. Install grooved-end couplings for valves in accordance with Section 400500.

H. Installing Extension Stem Guide Brackets

Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

I. Mounting Gear Actuators

The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

J. Field Installation of Gear Actuator

Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

K. Valve Field Testing

1. Test valves for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

2. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

3. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 40 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

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SECTION 400764 PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of pipe hangers and supports including accessory items such as anchor bolts and screws.

B. Related Work Specified Elsewhere

Painting and Coating: 099000.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.

PART 2 - MATERIALS

A. Design Criteria

1. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.

2. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.

B. Hanger and Support Systems

1. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.

2. Pipe hangers and supports shall comply with ANSI/MSS SP-58 for the standard types referenced in the drawings. Construct special hangers and supports if required or detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with ANSI/MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable steel clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102
2	Offset steel pipe clamp	Anvil Fig. 103 or 100
3	Steel double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	Steel pipe clamp (pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
4	Steel pipe clamp (pipes 3 inches and larger)	Anvil Fig. 216, B-Line 3142
5	Pipe hanger	B-Line B6690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable steel band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B5573
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	Steel turnbuckle	Anvil Fig. 230, B-Line B3202
14	Steel clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	Malleable iron socket	Anvil Fig. 110R, B-Line B3222
17	Steel weldless eye nut	B-Line B3200
18	Steel or malleable iron concrete insert	Anvil Fig. 281, Superstrut 452
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134
22	Welded attachment type	Anvil Fig. 66 B-Line B3083
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	Steel I-beam clamp with eye nut	Anvil Fig. 228
29	Steel wide flange	Anvil Fig. 228 clamp with eye nut
30	Malleable iron beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090

Type Number	Description	Manufacturer and Model (or Equal)
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B-Line B3114
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B-Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B-Line B3117SL

3. Pipe hangers and supports shall be hot-dipped galvanized per ASTM A153 carbon steel (ASTM A36, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A47).

C. Offset Pipe Clamp

Anvil Figure 103 or equal. Material shall be Type 304 stainless steel.

A. Steel Channel Framing System

1. Steel channel frames shall be 1-5/8 inches wide by 1-5/8 or 3-1/4 inches high by 12-gauge metal thickness, unless otherwise shown in the drawings. Material shall conform to ASTM A36, A1011 (Grade 33 minimum), or A653 unless stainless steel is indicated in the drawings. Stainless steel shall be Type 304. One side of the channel shall have a continuous open slot with inturned clamping ridges. Maximum allowable stress under any combination of applied uniformly distributed loads and concentrated loads shall not exceed those recommended in the AISC or AISI. Deflection shall not exceed 1/240 of span. Use multiple back-to-back channels to achieve these criteria if single channels are not sufficient. Products: Unistrut P1000 or P5000 Series, B-Line B11 or B22 Series, or equal.

2. Steel channels shall be hot-dipped galvanized per ASTM A153.

3. Nuts shall be machined and case hardened. Provide rectangular nuts with the ends shaped to permit a quarter turn crosswise in the framing channel. Provide two serrated grooves in the nut to engage the inturned edges of the channel.

4. Pipe clamps (including attachment screws and nuts) shall be Unistrut P1100 or P2000 Series, B-Line B2000 Series, or equal. Material shall be Type 304 stainless steel.

5. Hanger rods for trapezes shall be carbon steel (ASTM A36, A575, or A576) unless stainless steel is indicated in the drawings. Stainless steel hanger rod material shall comply with ASTM A276, Type 304.

6. Accessory fittings and brackets shall be the same material as the channel or trapeze. Provide coating on carbon steel fittings and brackets as specified for the channels and frames.

   a. Flat Plate Fittings: Unistrut P1065, P1066, P1925; Superstrut AB-206, AB-207; or equal.

   b. Post Bases: Unistrut P2072A, Superstrut AP-232, or equal.

c. 90-Degree Brackets: Unistrut P1326, P1346; Superstrut AB-203; or equal.

d. Rounded-End Flat Plate Fittings: Unistrut P2325, Superstrut X-240, or equal.

7. Parallel pipe clamps shall be Unistrut P1563 through P1573, Superstrut AB-719, or equal. Material shall be carbon steel, coated as specified for channels and frames.

D. Anchor Bolts and Screws

Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be 316 stainless steel. Nuts shall match anchor bolts.

PART 3 - EXECUTION

A. Pipe Hanger and Wall Support Spacing

Install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed in the drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes shown or detailed in the drawings. If no spacing or rod sizes are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe Hanger and Wall Support Spacing for Steel and Ductile-Iron Pipe

Pipe Size (inches)	Maximum Support or Hanger Spacing (feet)	Minimum Rod Size (inches)
3/8 and smaller	4	3/8
1/2 through 1	6	3/8
1-1/4 through 2	8	3/8
2-1/2 and 3	10	1/2
3-1/2 and 4	10	5/8
6	12	3/4
8	12	7/8
10 and 12	14	7/8

2. Pipe Hanger or Wall Support Spacing for PVC Pipe:

Pipe Size (inches)	Maximum Support or Hanger Spacing (feet)	Minimum Rod Size (inches)
3/4	4	3/8
1	4	3/8
1-1/2	5	3/8
2	5	3/8
2-1/2	5	1/2
3	6	1/2

3. For piping services not described, provide hangers and supports per MSS SP-58 and SP-69.

B. Pipe Support Spacing for Supports on Top of Slabs or Grade

Install pipe supports on horizontal runs at the spacing shown or detailed in the drawings. Provide supports of the type shown or detailed in the drawings. If no spacings are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe support spacing for other pipe materials shall be the same as described above in paragraph entitled “Pipe Hanger and Wall Support Spacing.”

C. Installing Pipe Hangers and Supports

1. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.

2. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.

3. Adjust pipe hangers per MSS SP-58, paragraph 14.6.

4. Install leveling bolts beneath support baseplates. Provide 3/4-inch thick grout pad beneath each base.

5. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

D. Installing FRP Channel Frames

1. Use 1-5/8-inch-high channel frames unless 3-1/4-inch is needed to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

2. Seal the ends of cut FRP channel frames with the channel manufacturer’s sealant or resin.

E. Painting and Coating

1. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.

2. Paint exposed pipe hangers and supports per Section 099000.

END OF SECTION

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SECTION 400775 EQUIPMENT, PIPING, DUCT, AND VALVE IDENTIFICATION

PART 1 - GENERAL

A. Description

This section includes materials and installation of markers, labels, and signs for pipes, ducts, and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

B. Related Work Specified Elsewhere

Painting and Coating: 099000.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.

PART 2 - MATERIALS

A. Labels for Exposed Piping

1. Labels for piping shall bear the full piping system name as shown in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels for piping inside buildings shall be vinyl cloth: W. H. Brady Co. B-500 vinyl cloth, Seton Name Plate Corporation Pipe Markers, or equal. Labels for piping located outdoors shall be weather- and UV-resistant acrylic plastic and shall be W. H. Brady Co. B-946, Seton Name Plate Corporation Pipe Markers, or equal.

2. Alternatively, provide preprinted, semirigid, snap-on, color-coded pipe markers. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Label shall cover 360 degrees (minimum). Labels shall be fabricated of weather- and UV-resistant acrylic plastic. Labels shall be Seton Nameplate Corporation SetMark pipe marks or equal.

B. Labels for Exposed Valves

Provide each valve of size 4 inches and larger with an identification tag. Tag shall be 2-inch-square or circular aluminum or 1/16-inch-thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings.

C. Labels for Mechanical Equipment

Provide a label for each pump, tank, feeder, or other piece of mechanical equipment. Label shall show the equipment name. Labels shall be 1 1/2 inches (minimum) by 4 inches (minimum) brass, aluminum, or 1/8-inch-thick fiberglass tags: Brady B-120 Fiber-Shield, Seton Style 2065, or equal.

D. Labels for Automatic Start/Stop Equipment

Provide a sign reading "CAUTION--EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on each piece of equipment listed below. Signs shall be pressure-sensitive vinyl with adhesive for application to equipment. Signs mounted on adjacent walls are also acceptable. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

Equipment Type	Location	Tag Number
Well pump and motor	Pump house	
NaOCl metering pump	Pump house	

E. Hazardous Materials Warning and Danger Signs

1. Provide hazardous materials warning diamond signs complying with NFPA 704. Size shall be 10 inches square. Wall signs shall be 1/8-inch-thick fiberglass: Brady B-120 Fiber-Shield or equal. Signs attached to tanks, cabinets, or pieces of equipment shall be self-adhesive vinyl cloth: Brady B-946 or equal. Provide signs at the following locations:

Room No.	Tag Number	Tank or Equipment	
		Location	Chemical
Pump house	--	Exterior of building door	NaOCl

2. Provide signs reading "DANGER" followed by the name of the chemical, gas, or hazard. Size shall be 10 inches by 14 inches. Signs shall be 1/8-inch-thick fiberglass: Brady B-120 or equal. Provide signs at the following locations:

Room No.	Sign Location	Name of Hazardous Material
Pump house	Over NaOCl tank	Sodium hypochlorite

PART 3 - EXECUTION

A. Installing Pipe Labels

1. Provide label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 20-foot centers on straight runs of piping.

2. On piping having external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.

3. On piping having external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers but not narrower than three times letter height (and of required length), fastened by one of the following methods:

   a. Laminated or bonded application of pipe marker to pipe or insulation.

   b. Strapped-to-pipe or insulation application of semirigid type with Type 304 or 305 stainless steel bands.

B. Installing Valve and Equipment Labels

1. Attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains or wires.

2. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

C. Installing Miscellaneous Signs

Attach per sign manufacturer's recommendations and per CAL/OSHA requirements.

D. Installing Wall and Door Signs

Attach to walls and doors using epoxy adhesive.

E. Installing Labels for Automatic Start/Stop Equipment and Hazardous Materials Warning Signs for Equipment

Attach signs for exposed equipment directly to the equipment.

END OF SECTION

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SECTION 402001 GENERAL REQUIREMENTS FOR STEEL PIPING

PART 1 - GENERAL

A. Description

This section includes general requirements for materials, fabrication, installation, and testing of steel pipe.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.

2. General Piping Requirements: 400500.

3. Pressure Testing of Piping: 400515.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM A53, A135, and A587 and AWWA C200. Show piping service (fuel oil, gasoline, water, air, etc.).

3. Submit piping layout drawings showing location and dimensions of pipe and fittings. Include laying lengths of valves, meters, in-line pumps, and other equipment determining piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:

   a. Material of construction, with ASTM or API reference and grade.

   b. Wall thickness of steel cylinder.

   c. Mortar lining thickness (if pipe has been specified to have a mortar lining).

   d. Mortar coating thickness, where mortar coating is required.

   e. Paint prime coating, where prime coat is required.

   f. Manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A53, ASTM A135, API 5L, AWWA C200.

   g. Show weld sizes and dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.

4. Submit coating application test records for field measuring paint coating thickness and holiday detection for each pipe section and fitting. Describe repair procedures used.

D. NDT Qualification

Personnel performing NDT shall meet the requirements of AWWA C200, Section 5 or shall be qualified as an AWS Certified Welding Inspector (CWI or SCWI) or shall hold a current AWS Radiographic Interpreter Certification.

PART 2 - MATERIALS

A. Steel Pipe Cylinders

1. The yield strength of the steel for pipe and fabricated fittings having grooved-end joints shall be minimum 35,000 psi.

2. Provide seamless pipe or pipe having straight longitudinal weld seams where pipe passes through rubber annular sealing devices.

B. Fittings

1. A fitting is defined as a special piece of pipe other than a normal straight section. Elbows, manhole sections, reducers, and sections with outlets are fittings.

2. Unless stated otherwise in the detailed pipe specifications, fittings shall comply with ASME B16.9 or AWWA C208, as follows:

   a. Specials and wrought steel butt-welded fittings 4 through 10 inches shall comply with ASME B16.9. Wall thickness shall be standard weight per ASME B36.10. Material for carbon steel fittings shall comply with ASTM A234, Grade WPB. Elbows shall be of the long-radius type unless otherwise shown in the drawings.

C. Joints

1. Provide plain-end pipe where flexible pipe couplings are to be provided. Provide lugs for thrust harnesses where shown in the drawings, per Section 400722.

2. Where piping connects to wall pipes, meters, valves, or other equipment, the pipe ends shall match the ends of the wall pipes, meters, valves, or equipment.

D. Outlets and Nozzles

1. Outlets of size 3 inches and smaller shall be of the thredolet type, per MSS SP-97 and AWWA Manual M11 (2004 edition), Figure 13-26. Outlets shall be 3,000-pound WOG forged steel per ASTM A105 or ASTM A216, Grade WCB. Threads shall comply with ASME B1.20.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or equal.

2. Alternatively, threaded openings not less than 2 inches or more than 3 inches in nominal size shall be a flat-bottom half-coupling conforming to ASME B16.11, Class 3000 and AWWA Manual M11 (2004 edition), Figure 13-25. Where the mounting surface is curved to a diameter of 36 inches or less, the mounting diameter shall be the same as that of the surface upon which it is to be mounted. Forge the threaded outlet and its plug from steel conforming to ASTM A105 or ASTM A181, Class 70.

3. For outlets 4 inches and smaller in piping smaller than 4 inches, use a tee with a threaded outlet.

4. For outlets larger than 4 inches, use a tee with a flanged outlet.

E. Grooved-End Couplings

1. Grooved-end couplings shall be ductile iron, ASTM A536, Grade 60-40-18 or 65-45-12. Gaskets shall be EPDM and shall conform to ASTM D2000. Victaulic Style 77 Flexible Coupling or equal.

2. Bolts in exposed service shall conform to ASTM A183, 110,000-psi tensile strength. Bolts in buried or submerged service shall be ASTM A193, Grade B8M, Class 2.

3. Grooved-end adapter flanges for pipe 18 inches and smaller having a maximum test pressure of 200 psi shall comply with ASME B16.1, Class 125 dimensions. Flanges shall be Victaulic Style 741 or 742, Gustin-Bacon Figure 154, or equal.

F. Flanges

1. Forged flange material shall conform to ASTM A105, A 181, or A 182. Steel flange material shall conform to ASTM A283 (Grade C or D), A285 (Grade C), or A36.

2. For test pressures 200 psi and less, use Class 150 flanges. For test pressures greater than 200 psi, use Class 300 flat-faced flanges.

3. Class 150 flanges shall comply with AWWA C207, Class D or E as follows. Use welding neck flanges conforming to ASME B16.5 in piping 10 inches and smaller where connecting to lug or wafer-style valves and in all sizes where connecting to wrought steel elbows and tees. Flanges shall be flat faced. Use the following pressure classes of flanges based on the specified test pressures:

Test Pressure (psi)	Pipe Size (inches)	Flange Pressure Class
175 and less	4 to 12	Class D
175 to 200	4 to 12	Class E
150 and less	14 to 144	Class D
150 to 200	14 to 144	Class E

4. Provide flat-faced flanges as described above where connecting to cast-iron flanges and where otherwise indicated.

5. Blind flanges shall comply with AWWA C207, Table 5.

G. Bolts, Nuts, and Gaskets for Flanges

See Section 400500.

H. Lubricant for Stainless Steel Bolts and Nuts

See Section 400500.

PART 3 - EXECUTION

A. Fabrication, Assembly, and Erection

1. Beveled ends for butt-welding shall conform to ASME B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.

2. Fabrication shall comply with ASME B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.

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

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

Welds shall be full penetration.

4. Use the shielded metal arc welding (SMAW) submerged arc welding (SAW), gas-shielded flux-cored arc welding (FCAW), or gas-metal arc welding (GMAW) process for shop welding. Use the SMAW process for field welding.

5. Welding preparation shall comply with ASME B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ASME B31.3, Table 341.3.2 and paragraph 341.4 for visual examination.

6. Identify welds in accordance with ASME B31.3, paragraph 328.5.

7. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

8. Welding electrodes for carbon steel piping shall comply with AWS A5.1, A5.17, A5.18, A5.36, or A5.23. Carbon steel flux cored wire shall have a maximum boron content of 0.003%.

B. Shop Testing of Fabricated or Welded Components

After completion of fabrication and welding in the shop and prior to the application of any lining or coating, test each component according to the referenced standards. Test fabricated fittings per AWWA C200 or AWWA C226. Test the seams in fittings that have not been previously shop hydrostatically tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix 8 and Section V, Article 6. In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested. Use the field hydrostatic test pressure or 125% of the design pressure, whichever is higher.

C. Product Marking

Plainly mark each length of straight pipe and each special and fitting at the bell end to identify the design pressure or head, the steel wall thickness, the date of manufacture, and the proper location

of the pipe item by reference to the layout schedule. For beveled pipe, show the degree of bevel and the point on the circumference to be laid uppermost.

D. Installing Flanged Piping

See Section 400500.

E. Installation of Stainless Steel Bolts and Nuts

See Section 400500.

F. Installing Grooved-End Piping

See Section 400500.

G. Installing Aboveground or Exposed Piping

See Section 400500.

H. Installing Buried Piping

Install in accordance with Section 312316.

I. Field Hydrostatic Testing

Hydrostatically test pipe and fittings in the field in accordance with Section 400515. See Section 400515 for test pressures.

J. Painting and Coating

See Section 099000.

K. Coating Buried and Submerged Bolts, Nuts, and Tie Rods

1. Coat buried bolts, nuts, and tie rods per Section 099000, System No. 24.

2. Coat submerged bolts, nuts, and tie rods per Section 099000, System No. 7.

L. Field Thickness Measurement and Repair of Paint Coatings for Steel Pipe

1. Field repair shop applied prime coats per Section 099000.

2. Test linings and coatings per ASTM G62, Method B, with a holiday detector set at 125 volts per mil coating thickness. Repair holidays and pinholes by applying the prime, intermediate, and finish coatings to each holiday or pinhole and retest.

3. Measure the lining and coating thickness on each pipe section using a calibrated coating thickness gauge. Make five separate spot measurements (average of three readings) spaced evenly over every 15 linear feet (or fraction thereof) to be measured. Make three gauge readings for each spot measurement of either the substrate or the paint. Move the probe a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low gauge reading that cannot be repeated consistently. Take the average (mean) of the three gauge readings as the spot measurement. The average of five spot measurements for each area shall not be less than the specified thickness. No single spot measurement in any area shall be less than 80%, or more than 120%, of the specified thickness. One of

three readings that are averaged to produce each spot measurement may underrun by a greater amount. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

4. Thickness determination shall meet the following requirements:

   a. No individual reading shall be below 75% of specified thickness.

   b. Individual spot readings (consisting of three point measurements within 3 inches of each other) shall have an average not less than 80% of specified thickness.

   c. The average of all spot readings shall be equal to or greater than nominal thickness specified.

5. Thickness determinations shall be conducted using a Type 1 magnetic thickness gauge as described in SSPC PA2 specification.

6. If the item has an insufficient film thickness, clean and topcoat the surface with the specified finish coatings to obtain the specified coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded coating, feathering the edges. Then coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

7. Steel pipe coating and coating repairs shall meet Section 099000, System No. 15. Steel pipe lining and lining repair shall meet Section 099000, System No. 7.

END OF SECTION

SECTION 402035 PLASTIC TUBING

PART 1 - GENERAL

A. Description

This section includes materials and accessories for flexible polyethylene tubing for chemical service.

B. Related Work Specified Elsewhere

Pressure Testing of Piping: 400515.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and descriptive literature for hoses, tubing, and couplings. Show pressure rating and materials of construction for tube, carcass, and cover. Show design of hose and tubing ends.

PART 2 - MATERIALS

A. Type 13: Flexible Polyethylene Tubing (1/4 Through 5/8 Inch)

1. Provide odorless and tasteless, NSF-61 certified, flexible black polyethylene tubing extruded from high molecular weight resin with smooth inside bore and smooth outside.

2. Minimum operating pressures shall be 120 psi for 1/4 through 3/8 inch, 90 psi for 1/2 inch, and 70 psi for 5/8 inch. Minimum operating pressure shall be 1/4 of the burst pressure of the tubing. Minimum bending radius shall be 2 inches. Joints and fittings shall be of the compression type utilizing a ferrule nut. Tubing shall comply with ASTM D1248, Type I, Class A, Category 4, Grade E and shall meet FDA and NSF 51 requirements for food contact applications.

3. Products: Parker “Parflex Polyethylene Tubing” with Parker “Fast & Tite” joints and fittings or equal.

B. Insert Fittings for Tubing

When insert fittings are specified, they shall be of the single-barb type. The completed tubing and fitting system shall have the same operating pressure ratings as specified for the tubing.

PART 3 - EXECUTION

A. Service Conditions

Service and design conditions for hoses and tubing shall be as follows:

1. Minimum working pressure of 100 psig.

2. Material conveyed shall be 12.5% sodium hypochlorite.

3. See drawings for hose or tubing size.

B. Field Testing

Hydrostatically test tubing for leakage in accordance with Section 400515. Leakage shall be zero. Test pressure shall be as shown in Section 400515.

END OF SECTION

SECTION 402053 CARBON STEEL PIPE (16 INCHES AND SMALLER)

PART 1 - GENERAL

A. Description

This section includes materials and installation of carbon steel pipe and fittings 16 inches in diameter and smaller for water service with a maximum design pressure of 300 psi.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. General Piping Requirements: 400500.
3. Pressure Testing of Piping: 400515.
4. Manual, Check, and Process Valves: 400520.
5. Pipe Hangers and Supports: 400764.
6. Equipment, Piping, Duct, and Valve Identification: 400775.
7. General Requirements for Steel Piping: 402001.

C. Submittals

Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

PART 2 - MATERIALS

A. Pipe

1. Pipe shall be black carbon steel conforming to ASTM A53, Type E or S, Grade B; ASTM A106, Grade B; ASTM A135, Grade B; or ASTM A587 with Supplementary Requirement S1 "Hydrostatic Testing." A nondestructive electric test per the previously cited ASTM pipe specifications may be substituted for the hydrostatic test.
2. Pipe 3 inches and smaller shall be Schedule 80 per ASME B36.10, except where greater wall thickness is required to accommodate lugs for thrust harnesses on flexible pipe couplings; see Section 400722.
3. Pipe larger than 3 inches having other than grooved-end joints shall be either standard weight or Schedule 20 per ASME B36.10, except where greater wall thickness is required to accommodate lugs for thrust harnesses on flexible pipe couplings; see Section 400722.
4. Piping larger than 3 inches having grooved-end joints shall be Schedule 80 per ASME B36.10, except where greater wall thickness is required to accommodate lugs for thrust harnesses on flexible pipe couplings.
5. See Section 402001 for additional requirements.

B. Threaded Nipples

Use same material as the pipe. Threads shall conform to ASME B1.20.1.

C. Fittings

1. Fittings 3 inches and smaller shall be Class 300, threaded, malleable iron (ASTM A47 or A197) conforming to ASME B16.3. Alternatively, use threaded forged steel fittings (ASTM A105) conforming to ASME B16.11, 3,000-pound CWP.

2. Fittings for buried pipe larger than 3 inches shall be flanged or butt-welded, conforming to ASME B16.9. Material shall conform to ASTM A234, Grade WPB. Wall thickness shall be the same as the pipe as a minimum.

3. Fittings for aboveground, exposed, or submerged pipe larger than 3 inches shall be flanged, conforming to ASME B16.9 or grooved-end, ductile iron (ASTM A536) or steel (ASTM A53, Grade B), with flexible-type grooving per AWWA C606, Table 3. Wall thickness shall be the same as the pipe as a minimum.

4. Material for flanged steel fittings shall conform to ASTM A234, Grade WPB. Wall thickness (except for grooved ends) shall be the same as the pipe.

D. Unions

Unions shall be Class 300, malleable iron (ASTM A47 or A197) brass to iron seat, conforming to ASME B16.39. Ends shall be threaded per ASME B1.20.1.

E. Joints

1. Joints for pipes 3 inches and smaller shall be threaded, malleable iron (ASTM A47 or A197), Class 300, conforming to ASME B16.3; or steel, conforming to ASTM A865 (hot-dipped galvanized).

2. Joints for buried pipe larger than 3 inches shall be butt-welded.

3. Joints for aboveground, exposed, or submerged pipe larger than 3 inches shall be grooved end or flanged. Grooved-end joints shall comply with AWWA C606, Table 3 (flexible type).

4. Do not field weld to join pipe and fittings that have been factory coated or lined with epoxy or polyurethane. If connections in addition to those shown in the drawings are required to field join pieces, use either flanged or grooved-end joints.

F. Outlets and Nozzles

See Section 402001.

G. Grooved-End Couplings

1. See Section 402001.

2. Couplings shall be flexible type, square cut groove, per AWWA C606. Couplings shall be Victaulic Style 77, Gustin-Bacon Figure 100, or equal.

H. Thread Lubricant

Use Teflon thread lubricating compound AND Teflon tape.

I. Flanges

1. Provide weld-neck flanges (conforming to ASME B16.5) for piping 3 inches and smaller to connect to flanged valves, fittings, or equipment. Provide weld-neck or slip-on flanges for piping larger than 3 inches. Slip-on flanges shall be double welded per ASME B31.3. Flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment. Flange material shall conform to ASTM A105, A181, or A182. Flanges shall be flat face.

2. Determine the pressure class of the flanges based on the test pressures shown in Section 400515. For test pressures 200 psi and less, use Class 150 flanges, ASME B16.5. For test pressures greater than 200 psi, use Class 300 flanges, ASME B16.5.

J. Bolts and Nuts for Flanges

See Section 400500.

K. Lubricant for Stainless Steel Bolts and Nuts

See Section 400500.

L. Gaskets for Flanges

See Section 400500.

PART 3 - EXECUTION

A. Fabrication, Assembly, and Erection

See Section 402001.

B. Installing Threaded Piping

Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant and Teflon tape to threaded ends before installing fittings, couplings, unions, or joints.

C. Installing Flanged Piping

See Section 400500.

D. Installation of Stainless Steel Bolts and Nuts

See Section 400500.

E. Installing Grooved-End Piping

See Section 400500.

F. Installing Aboveground or Exposed Piping

See Section 400500.

G. Locating Unions and Grooved-End Couplings

Provide unions on exposed piping 3 inches and smaller and grooved-end couplings on exposed piping larger than 3 inches having butt-welded joints as follows:

1. At every change in direction (horizontal and vertical).

2. Six to twelve inches downstream of valves.

3. Every 40 feet in straight piping runs.

4. Where shown in the drawings.

H. Field Pressure Testing

See Sections 402001 and 400515.

I. Painting and Coating

1. Line new pipe and any existing pipe with damaged lining per Section 099000, System 7.

2. Coat piping located above ground and in structures per Section 099000, System No. 15. Apply prime coat at shop.

3. Coat buried piping per Section 099000, System No. 25.

4. See Section 402001 for additional requirements.

J. Coating Buried and Submerged Bolts, Nuts, and Tie Rods

See Section 402001.

K. Field Measuring Paint Coating Thickness

See Section 402001.

END OF SECTION

SECTION 405000 PROCESS CONTROL AND INSTRUMENTATION SYSTEM (PCIS) GENERAL REQUIREMENTS

PART 1 - GENERAL

A. Description

1. This section of the specifications includes materials, testing, and installation of process control and instrumentation system as specified herein and indicated on the drawings.

2. These specifications shall not be interpreted as permission or direction to violate any governing code or ordinance. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:

   a. Instrumentation: ISA - The International Society of Automation.

   b. Wiring: National Electrical Code (NEC), ISA S5.3 and S5.4.

   c. Control Panels: NEMA Standards Publication 250-2003.

   d. Control Logic: NFPA 79.

   e. Piping: ANSI B31.3 (instrumentation piping).

B. Related Work Specified Elsewhere

1. Process Control and Instrumentation System Loop Descriptions: Section 405010.

2. Instrumentation Equipment: Section 405020.

3. Programmable Logic Control System: Section 405040.

4. Instrument Control Panel (ICP): Section 405080.

5. Pressure Gauges and Pressure Switches: Section 409715.

C. Scope of Work

1. The work involves furnishing all hardware and software, programming, installation, labor, material, equipment, and engineering in strict compliance with the contract documents for the City of Turlock.

2. The work involves programming for existing equipment and future logic per contract drawings.

D. Submittals

1. PCIS Integrator Qualification Evidence

   a. Submit PCIS Integrator Qualification Evidence per Section 405000 Part 1 Paragraph E.2 below.

   b. Qualification Evidence shall be submitted prior to commencement of the work.

2. Detailed System Drawings and Data:

    a. The submittal shall consist of six sets of detailed drawings and data prepared and organized by the Contractor. All drawings, schematics, layouts, and diagrams shall be done on 11" x 17" sheets utilizing AutoCAD.

    b. Drawings shall contain only relevant simplified details using symbol approach. Photographic images of components depicting irrelevant details (screws, holes, logos, etc.) are not allowed.

    c. Drawings prints shall not contain details and texts smaller than 3/64”.

3. Two sets of submittals will be returned to the Contractor.

4. Submit these drawings and data as a complete package at the same time.

5. Submittals shall be in three-ring hardcover binders and arranged for convenient use including tab sheets, all indexed, and cross referenced with a separate index for each item.

6. Provide manufacturers cut sheets and manuals for all hardware to be provided.

7. Provide an Instrument Index.

8. Provide ISA type instrumentation data sheets for each component, together with a technical product brochure or bulletin. The data sheets, as a minimum, shall show:

    a. Instrument tag designation.

    b. Component name.

    c. Manufacturer's model number.

    d. Calibrated range.

    e. Instrument location.

    f. Input and output characteristics.

    g. Scale range and units (if any) and multiplier (if any).

    h. Requirements for electric supply.

9. Group the data sheets together in the submittal by type. Provide individual data sheets for each instrument with one brochure or bulletin to cover all identical uses of that component.

10. The detailed construction drawing submittal shall include, as a minimum, the following types of drawings and diagrams required for the construction of this project:

    a. Legend, Symbols, and Index.

    b. System Block Diagrams.

    c. Power Distribution Diagrams.

d. Instrument Control Panel Layouts/Construction Drawings/Details. The drawings shall include the following:

(1) Dimensions

(2) Location of all components

(3) Identification of all components

(4) Bill of Materials

(5) Conduit entry area.

e. PLC/RTU Rack Elevation Drawing for each PLC/RTU.

f. Internal Panel Wiring Diagrams.

g. Digital I/O Module Wiring Diagrams.

h. Analog I/O Module Wiring Diagrams.

i. Detailed NFPA 79-style Ladder Diagrams (for discrete wiring) to meet the following minimum requirements:

(1) Each subassembly shall be shown as a rectangle in the diagram with all external terminals identified. Terminals unknown at the time of the submittal shall be left blank, to be filled later. Single contacts internal to the subassemblies shall be shown in the rectangle connected to their terminal points.

(2) Where the internal wiring diagrams of subassemblies are furnished on separate sheets, they shall be shown as a rectangle in the schematic diagram with all external points identified and cross-referenced to the separate sheets of the control circuit. Coils and contacts internal to the subassemblies shall be shown in the rectangle connected to their terminal points.

(3) Show unique rung numbers on left side of each rung. A cross-referencing system shall be used in conjunction with each relay coil so that associated contacts may be readily located on the diagram. The contacts shall be referenced to coils as well, so that associated coils may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, the purpose of the contact shall be described on the same sheet. Spare contacts shall be shown.

(4) Limit, pressure, float, flow, temperature sensitive, and similar switch symbols shall be shown on the schematic (ladder) diagram with all utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position. If the equipment is shown in a specific position, the position shall be identified.

(5) Contacts of multiple contact devices, e.g., selector switches, shall be shown on the line of the schematic diagram where they are connected in a circuit. A mechanical connection between the multiple contacts shall be indicated by a dotted line or arrow. This does not apply to control relays,

starters, or contactors. Additional charts or diagrams may be used to indicate the position of multiple contact devices such as drum, cam, and selector switches.

(6) The purpose or function of all switches shall be shown adjacent to the symbols. The purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram shall be shown adjacent to their respective symbols. The number of positions of the solenoid valve shall be shown adjacent to the valve solenoid symbol.

j. Detailed Loop Interconnection Wiring Diagrams (per ISA S5.3 and S5.4) for the entire system showing all control equipment, instrumentation, electrical equipment, components, wiring, routing, boxes (pull, junction, and terminal junction), terminations, wire tags, and wire colors. The diagrams shall show the detailed interconnection of all electrical equipment, instrumentation, panels, enclosures, components and the like provided under this contract.

k. Arrangement and construction drawings for consoles, control panels, and for other special panels for field installation. These drawings shall include dimensions, location of all components, identification of all components, bill of materials, detailed schematics of all internal wiring, preparation and finish data, nameplates, and the like. These drawings also shall include enough other details to define the style and overall appearance of the assembly; include a finish sample for all panel surfaces.

l. Installation, mounting, and anchoring details for all field instruments and panel mounted components.

m. An instrument list including all instruments provided under this project.

n. An I/O List for each PLC/RTU in the project.

11. Detailed System Software Submittal: The submittal shall consist of six sets of the software system descriptions and diagrams. Two sets of submittals will be returned to the contractor. The software submittal can be made as a separate package to be inserted in the original submittal. The following items must be submitted at least eight weeks prior to the factory witness test orientation:

a. Detailed PLC/RTU software logic diagram printouts for each PLC/RTU. Logic diagrams shall be fully annotated such that an individual unfamiliar with the diagram format can fully understand the process control logic presented.

b. An updated I/O List for each PLC/RTU in the project.

c. Narrative control descriptions for each analog and discrete control loop. Loop descriptions shall describe how each control loop will operate, the PLC control logic, SCS control and monitoring capabilities and in general a job specific description of each control loop in the system.

d. Sample color printouts of each CRT display, sample printouts of each Operator Interface display, report, and log for the supervisory control system (SCS) software.

12. Complete detailed bills of material: Detailed bill of material for all components shall be provided including complete manufacturers name and model number, quantity to be provided, and cross references to data sheet sections.

13. Operation, Maintenance, and Repair Manuals (OMM):

    a. The organization of the initial submittal required above shall be compatible to eventual inclusion as one volume of the operation, maintenance, and repair manuals.

    b. Operation manuals shall be prepared and submitted to the Owner's Representative for preliminary review in six copies. When the Owner's Representative is satisfied that these are complete and properly prepared, six final sets shall be delivered to the Owner's Representative.

    c. The complete OMM shall contain the following:

        (1) All the information included in the preliminary equipment submittal, the detailed installation submittal, and the additional information required herein, all bound in hard-cover binders and arranged for convenient use including tab sheets, all indexed and cross referenced with a separate index for each item.

        (2) All final “as-built” drawings with the AutoCAD electronic files.

        (3) Electronic files for all PLCs, Operator Interfaces, and SCADA programming.

        (4) Calibration and maintenance instructions.

        (5) Trouble-shooting instructions.

        (6) Instructions for ordering replacement parts.

E. Qualifications and Responsibility of Contractor

1. The Contractor shall furnish and install all proposed hardware as shown on the drawings and as specified herein. The PLC system installation and wiring connections to peripheral equipment and instruments shall be the responsibility of the system supplier using qualified personnel possessing the necessary equipment and having experience in making similar installations. Evidence of such qualification, as well as notification of the system supplier assuming unit responsibility, shall be furnished to the Owner in writing for approval prior to commencement of the work.

2. Qualification Evidence: The qualification evidence shall include the following:

    a. Verification that the system supplier shall have had a minimum of five years' experience with the installation and programming of industrial control systems similar in type to those to be installed in this project.

    b. Verification that the Contractor is Control Systems Integrators Association (CSIA) Certified.

    c. A list of completed similar installations including name, address, and telephone number of the owner, name of project, and date of completion.

    d. The name and qualifications of supervisory personnel to be directly responsible for the programming and installation of the control system.

3. The PCIS Integrator shall be Control Systems Integrators Association (CSIA) certified member.

4. Under this section, the Contractor shall furnish the following:

    a. Instrumentation equipment (Section 405020).

    b. PLC, HMI, and UPS (Section 405040).

    c. Control cabinets (Section 405080).

    d. Spare parts per Sections 405020, 405040, 405050, and 405080.

    e. Special tools and test equipment required by the supplier.

    f. Installation, integration and testing.

    g. Documentation.

    h. Operator training.

    i. Warranty (one year).

    j. Shipping and receiving.

5. All calibration and final checkout of the process control and instrumentation system shall be witnessed by the Owner's Representative to determine if the system complies with the contract documents.

6. The Contractor shall be responsible for coordinating and interfacing with equipment supplied under these contract documents, which are an integral part of the system. Interfacing shall be incorporated in the detailed systems drawings and data section of the contract documents.

7. The system supplier shall be experienced in the design, programming, and service of this type of equipment. In the event of a dispute as to the acceptability of the system supplier, the Owner's Representative shall make the final determination.

F. Guarantee

1. The Contractor shall repair or replace defective components, rectify malfunctions, correct faulty workmanship, all at no additional cost to the Owner during the warranty period.

2. To fulfill this obligation, the Contractor shall utilize qualified technical service personnel designated by the Contractor who was originally assigned project responsibility. Services shall be performed within five calendar days after notification by the Owner's Representative.

G. Measurement and Payment

Payment for the work in this section shall be included as part of the lump-sum bid amount stated in the Proposal.

PART 2 - MATERIALS

A. Designations of Components

In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

B. Instrument Tagging

Attach a stainless-steel tag to the instrument at the factory. Permanently mark the stainless-steel tag with the instrument tag number and the instrument calibration range. The manufacturer's standard metal nameplate as a minimum shall denote model number, serial number, operating electrical voltage and amperage (when applicable), and date of manufacture.

C. Instrument System Power

1. Power provided for the instrument system at the facility shall be 120-volt a-c, single phase, 60 Hz.

2. Where d-c power supplies are not furnished integral with any one instrument system loop, then provide separate solid-state power supplies.

D. Matching Style, Appearance, and Type

All display instruments of each type shall represent the same outward appearance, having the same physical size and shape and the same size and style of numbers and pointers.

PART 3 - EXECUTION

A. Uniformity of Components

Components, which perform the same or similar functions, shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and the same appearance.

B. Mounting of Equipment and Accessories

Mount equipment in accordance with the installation detail drawings as prepared by the Contractor and reviewed by the Owner’s Representative. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Do not install consoles, cabinets, and panels until heavy construction work adjacent to computer and telemetry equipment has been completed to the extent that there shall be no damage to the equipment.

1. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.

2. Mount local equipment in cabinets or existing panels as specified. Mount associated I/O terminals on a common panel or rack; mounting panels and rack shall be baked enamel.

3. Coordinate the installation of the electrical service to components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation supervised by the Contractor.

4. Test the completed system after installation to assure that all components are operating with the specified range and all interlocks are functioning properly.

5. Tubing Valves, and Fittings: All instrument tubing manifolds shall be Type 316 stainless steel, unless otherwise specified elsewhere in these specifications. Tubing runs to transmitters shall be installed with a positive slope in one direction. Fittings and valves shall be Type 316 stainless steel. Block/bleed valves shall be as manufactured by Hex Valve Series HB59, or equal.

C. Calibration

1. Each instrument requiring factory calibration shall be furnished with calibration data. The calibration data shall be factory certified.

2. Calibrate systems after installation in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements, which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. Accomplish this calibration work by a technical field representative of the single instrument supplier. He shall certify in writing to the Owner’s Representative that all calibrations have been made and that all systems are ready to operate.

D. Factory Testing

1. The fully configured SCADA system shall be successfully submitted to a factory acceptance test before shipment to the jobsite.

2. For testing purposes SCADA system shall reside on a Contractor’s laptop or desktop. Graphics shall be displayed on a monitor size wise identical to the existing one at the LPUD.

3. Instrument Control Panel(s) shall be fully assembled and wired.

4. Factory testing shall take place at the PCIS Integrator’s facility located in California.

5. The factory test will be for a minimum of one (1) day. Allow additional time for setup, breakdown and pre-testing.

6. Prior to factory system testing, submit a written detailed test procedure for review by the Owner. Notify the Owner in writing four weeks in advance of the scheduled testing.

7. Factory witness tests shall demonstrate that the system will perform each operation required for all specified conditions, including both normal and emergency operations and conditions. Provide a certification and log of all tests to the Owner for review and comment.

8. Check panel wiring against approved submittal drawings. Record any changes made during testing of the equipment on the record drawings.

9. The system shall be exercised through operational tests, under factory-simulated conditions to demonstrate that the system is fully configured to perform all control, logic, monitoring, reporting, logging, archiving and communications functions as specified and that the system is ready for field installation. All test equipment required to simulate actual field conditions shall be provided by the control system contractor.

10. The factory witness test shall take as long as necessary to demonstrate to the Owner and the Owner's Representative that the system performs each operation.

11. A return visit to the Contractor's facility for re-testing will be at the total expense of the Contractor.

E. Field Testing

1. Exercise systems through field tests in the presence of the Owner in order to demonstrate achievement of the specified performance.

2. Coordinate field tests dependent upon completion of work specified elsewhere. Schedule tests among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

F. 5-day Acceptance Test

1. When systems are assessed to have been successfully carried through a complete operational test and the Owner concurs in this assessment, a date to start the system acceptance test involving the Owner's operating personnel will be agreed upon.

2. Recheck the systems at this time to verify proper operation, and make final adjustments. The system testing shall consist of five (5) consecutive days (Monday – Friday) of continuous testing utilizing the Owner's day shift working hours. The Contractor shall be on call ready to respond to the site within two hours after day shift working hours and on weekends. The Owner's representative will determine the severity of the problem to the best of his ability and contact the Contractor for disposition. This arrangement will in no way relieve the system supplier of responding within 2 hours and resolving the problem in a mutually agreed upon time frame not greater than 48 hours.

3. The acceptance tests shall have a success factor of 95% system uptime. If the system should fail below the 95% factor, correct the system problems. System start-up shall start over again from day one. This will continue until the system functions for five consecutive days with a 95% uptime success factor.

G. Operator Training

1. Provide the Owner's operating personnel and/or the Owner's Representative with three (3) days of formal instruction in the functions and operations of each system provided under this contract. The training shall cover overall system theory, hardware architecture, the operating system, programming instruction in the applicable languages, utility, programs, system generation, and diagnostics. The programming instruction shall include program development, coding, sample programs, and debugging at every programming level. Actual programming exercises and hands-on experience shall be emphasized. Emphasis shall also be placed on safety features and features, which may require readjustment, resetting or checking, and recalibration by them from time to time.

2. Provide the training sessions at the Owner's facilities and on the equipment furnished under this contract. The education and instruction of operating personnel shall be by a qualified

instructor familiar with the requirements for this project. Each training session shall be for eight hours of formal instruction. Session dates shall be directed by the Owner. There will be three (3) non-consecutive one-day training sessions, which shall not coincide with any system testing or start-up activities.

END OF SECTION

SECTION 405010 PROCESS CONTROL AND INSTRUMENTATION SYSTEM (PCIS) LOOP DESCRIPTIONS

PART 1 - GENERAL

A. Description

1. The descriptions, together with the detail drawings, instrumentation diagrams, comprise the functional design criteria of the Process Instrumentation and Control System (PCIS). The process and instrumentation diagrams (P&IDs) represent the basic concept of the PCIS requirements, whereas the descriptions supplement the instrumentation diagrams.

2. The PCIS Supplier shall utilize the descriptions and P&IDs as the basic criteria for the design of the instrumentation schematics, control software, preparation of data sheets, wiring diagrams, piping layouts, assembly drawings, and other requirements set forth in these specifications.

3. The PCIS will provide an integrated control and reporting system. The function of this system is to monitor, control, report, and safeguard the system. The PCIS system will be based on remote terminal units, linked to a SCADA computer and peripherals, with selected monitoring and alarm functions displayed in the control room.

4. Status-to-Command Disagreement (STCD):

   a. Provide a STCD alarm for all equipment controlled with the control system. The STCD alarm shall be initiated if a piece of equipment is commanded to start/stop or open/close by a PLC and the appropriate run or position status is not reported back within a time interval.

   b. STCD alarm shall be latched, unless specified otherwise.

   c. Typical STCD reset shall be accomplished by toggling AUTO (READY, REMOTE) signal back to AUTO (READY, REMOTE), unless specified otherwise.

5. Provide high-high, high, low, low-low, rate of change and instrument fail alarms for all analog points in the system. If a particular alarm is used by ladder logic, or requires to be displayed at local Operator Interface, that alarm shall be implemented at the PLC.

6. All software switches shall be implemented with associated time delays. Time delay value shall be pre-programmed initially to 10 seconds, unless specified otherwise.

7. All flow values and motors elapsed running time shall be totalized and stored at the PLC. Those totals shall be non-resettable.

8. All scaling of analog signals shall be implemented at the PLCs. Each PLC shall interface with an Operator Interface and with PLC network/SCADA System using data in engineering units.

9. At each PLC the processor shall monitor the internal operation of the PLC and communication system for failures. If a failure is detected, a dry contact closure shall close and illuminate the “PLC Fail Light” at an ICP.

10. SCADA System shall monitor communication with each PLC. If a communication failure with a PLC is detected, an alarm shall be generated and logged.

B. Related Work Specified Elsewhere

1. PCIS General Requirements: 405000.

2. Instrumentation Equipment: 405020.

3. Programmable Logic Controller and Operator Interface: 405040.

4. Instrument Control Panel: 405080.

PART 2 - LOOP DESCRIPTIONS

A. Loop 111, Well Control

1. Well Control Logic

a. Well is treated as not available when at least one of the following conditions is present:

(1) Well is not in AUTO at the SCS;

(2) Well READY signal from the VFD is not detected;

(3) Any fail alarm signal from VFD is detected;

(4) Well STCD is detected.

2. Operator shall be able to “Call” to operate the pump from SCS.

3. Operator shall be able to adjust the VFD speed from SCS.

4. PLC shall monitor the “Run” status of the pump motor and report it to SCS for indication and logging.

5. PLC shall report “Fail” status to SCS for alarming.

B. Loop 113, Flow Monitoring

1. Flow shall be monitored by PLC and values shall be reported to SCS for indication and recording.

2. When well pump is running, flow value shall be totalized.

3. When the well is running and the flow remains below or above the pre-programmed flow setpoints for a pre-programmed time interval, an alarm shall be generated.

C. Loop 211, Nitrate Analyzer Monitoring

1. Nitrate values shall be monitored by AIT-211 and shall interface to SCS for indication and recording.

2. PLC shall generate High Nitrate alarm for indication and recording.

D. Loop 213, Waste Valve

1. The waste valve shall open on “High Nitrate” alarm per para C.2 above.

2. The waste valve “Open” position status shall be monitored by PLC for indication and recording.

E. Loop 215, Distribution Valve

1. The distribution valve “Open” position status shall be monitored by PLC for indication and recording.

F. Loop 217, Chlorine Analyzer Monitoring

1. Chlorine values shall be monitored by AIT-217 and shall interface to SCS for indication and recording.

2. PLC shall generate High Chlorine alarm for indication and recording.

G. Loop 219, Distribution Pressure Monitoring

Distribution pressure shall be monitored by pressure transmitter PIT-219 and reported to SCS for indication and recording.

H. Loop 300, NaOCL Tank Monitoring

1. Tank level shall be monitored by a level transmitter LT-300 and transmitted to the PLC.

2. LS-300 shall detect and transmit an alarm for any leak in the tank wall.

I. Loop 311, Metering Pump

1. Metering pump shall be called to operate when the well is running.

2. Metering pump VFD shall be paced to maintain dosage (ppm)/flow (gpm) ratio. Operator shall be able to enter the desired ratio at the HMI.

3. PLC shall monitor flow pulses generated by Flow Switch FS-300.

4. When lack of flow pulses is detected, while there is a demand, a Low Sodium Hypochlorite Flow alarm shall be generated.

J. Loop 989, UPS Monitoring

Alarms shall be transmitted to the SCS when PLC detects “UPS Common Alarm” or “UPS on Battery” alarm.

K. Loop 999, Emergency Eyewash Flow Monitoring

Emergency eye wash flow detection and alarm shall be monitored and reported to SCS.

PART 3 – EXECUTION

See Section 405000.

END OF SECTION

SECTION 405020 INSTRUMENTATION EQUIPMENT

PART 1 - GENERAL

A. Designations of Components

In these specifications and on the plans, all systems, meters, instruments, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

B. Signal Characteristics

Wherever possible and feasible, components shall be of electronic solid-state design and systems shall utilize the same signal characteristics throughout each and all of the several systems; transmission signals shall be 4 mA to 20 mA. The combined power supply and transmitter loops shall, when tested with appropriate precision resistors, present a voltage signal of 1- to 5-volt DC. Signal isolators shall be provided where required.

PART 2 - MATERIALS

A. Ultrasonic Level Transmitter - Single-Piece

1. The level measuring system shall be of the ultrasonic type based in a single-point compact, probe-type system, consisting of a complete microprocessor based electronic transmitter/transducer. The unit shall be housed in a compact NEMA 4X rated enclosure, and shall be capable of generating, transmitting, receiving and processing ultrasonic signals and converting those signals into a 4 mA to 20 mA output proportional to either liquid level or free air space.

2. The selection of operating parameters shall be entered into the unit in a two (2) step process with the material level at its corresponding 4 mA value, generally the low level and its corresponding 20 mA value, generally the high level.

3. The output signal from the probe-type unit shall be 4 mA to 20 mA into 750 Ω at 24 VDC. The power supply shall be 18 VDC to 30 VDC with a maximum power consumption of 5 W (200 mA at 24 VDC). The measuring range shall be from 0.8 feet to 16.4 feet. The measurement accuracy shall be 0.25% of target range (in air). Air temperature compensation shall be built-in to nose cone. The status relay shall have contact closure on loss of echo after 10 minute delay, or internal failure, or loss of power. The probe-type unit shall have an operating temperature range of -5 °F to +140 °F continuous. The nose cone in process shall have a maximum operating temperature of 230 °F for 30 minutes. The maximum operating pressure shall be 30 psig. The mounting options shall be either 2" NPT threaded nose or universal mounting flanged to suit 3" ANSI flange.

4. The transmitter/transducer shall be SITRANS Probe LU as manufactured by Siemens Energy and Automation Milltronics.

1.	Tag No.	LT-300
2.	P&ID No.	N-602
3.	Service	Level
4.	Type	Ultrasonic
5.	Function	Transmit Level
6.	Transducer Material	Kynar
7.	Range, feet	0-5
8.	Mounting	DWG. N-501 Det. 3

B. Pressure / Level Transmitter

1. The pressure transmitter shall be of the microprocessor-based type 2-wire system. The transmitter shall operate from a 24 V dc source. The output signal shall be 4 mA to 20 mA dc. The transmitter shall be housed in a NEMA 4X enclosure.

2. Configuration data shall be stored in nonvolatile EEPROM memory in the transmitter electronics module. This data shall be retained in the transmitter when power is interrupted, so the transmitter shall be functional immediately upon power up. The transmitter shall perform continuous self-tests. In the event of a problem, the transmitter shall activate the user-selected analog output warning. A HART Communicator or other HART-based communications device shall be able to interrogate the transmitter to determine the problem. The transmitter shall output specific information to the communicator identifying the problem for fast and easy corrective action.

3. The pressure transmitter shall provide an electronic signal proportional to the calibrated pressure range. The pressure-sensing element shall be silicone oil filled with a process media operating temperature range of -40 °F to 250 °F. An integral stainless steel block/bleed manifold (pre-assembled to the transmitter and leak checked) shall be provided for each transmitter. The manifold shall have a block and a vent/test valves.

4. Provide the pressure transmitter with the following features:

   a. Independent external zero and span adjustments.

   b. Overrange protection.

   c. Integral digital indicator, calibrated in engineering units.

5. Accuracy of the pressure transmitter shall be ±0.1% of calibrated span.

6. The pressure transmitter shall be manufactured by Rosemount, Model 2051 with Model 306RT1 Block-and-Bleed Manifold.

	GENERAL	
1.	Tag No.	PIT-219
2.	P&ID No.	N-601
3.	Service	GAC to Distribution
4.	Type	Piezoresistive Gage
5.	Function	Transmit Pressure
	ELEMENT	
6.	Element Material	316 SST
7.	Body Material Mfg.	Std.
8.	Connection Size	1/2-inch NPT
	TRANSMITTER	
9.	Location	Tank
10.	Mounting	Bracket
11.	Area Class	NEMA 4
12.	Calibration	0-100 psi
13.	Output	4 mA - 20 mA dc
14.	Indication	Yes
15.	Output to	PLC
16.	Power	24 V dc
17.	Install. Detail	DWG. N-501 Det. 2

C. Flow Monitoring System

1. Flow Monitoring System

2. Provide a low flow sensor for sodium hypochlorite injection system. The flow sensor shall be of the flow-through type with the ability to detect minimally acceptable flow. All wetted surfaces shall be compatible to sodium hypochlorite.

3. Flow sensor shall interface with a flow monitor to be installed in ICP.

4. Flow Monitoring System components shall be by ifm efector, as follows:

   a. Flow Sensor: Mod. SF2410

   b. Flow Monitor: Mod. SN0150

   c. Flow Adaptor: Mod. U40087

5. Deliver Flow Sensor and Flow Adapter for field installation at the injection point.

END OF SECTION

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SECTION 405030 ANALYTICAL INSTRUMENTS - NITRATE

PART 1 - GENERAL

A. Description

This section includes requirements for materials, testing, and installation of a nitrate analyzer.

B. Related Work Specified Elsewhere

PCIS General Requirements: 405000.

C. Designations of Components

In these specifications and on the plans, all systems, meters, instruments, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

D. Signal Characteristics

Wherever possible and feasible, components shall be of electronic solid-state design and systems shall utilize the same signal characteristics throughout each and all of the several systems; transmission signals shall be 4 mA to 20 mA. The combined power supply and transmitter loops shall, when tested with appropriate precision resistors, present a voltage signal of 1- to 5-volt DC. Signal isolators shall be provided where required.

PART 2 - MATERIALS

A. Nitrate Analyzer

1. Provide nitrate analyzing system consisting of nitrate sensor and controller for continuously monitoring nitrate in water.

2. Nitrate Sensor: The nitrate sensor shall be a continuous-reading sensor that utilizes a multiple-wavelength spectrophotometric technology. The sensor shall have the following features:

    a. A reference beam at 350 nm to provide a reference standard to correct for interference by turbidity and organic matter up to 150 mg/L.

    b. No reagents.

    c. A stainless steel probe and 10-meter long cable.

    d. A self-cleaning wiper system to prevent surface film or particles.

    e. Automatic zero adjustment using deionized water.

f. Measurement range: 0.1 to 100 mg/L for nitrate (NOx-N). Accuracy: ±5 percent of mean ±1.0 or better. Resolution: 0.1 mg/L.

g. 2-beam UV absorption technology with 2-mm path length.

h. Maximum detection time for each sample line shall be 15 seconds.

3. Provide adequate zeroing and cleaning solution for six months of continuous sampling.

4. The product shall include a one year warranty from the date of shipment.

5. The measurement interval shall be user-selectable from one to 30 minutes. Up to 12 signals can be averaged.

6. The nitrate analyzer shall be a Nitratax UV Nitrate Sensor Model Nitratax Plus SC as manufactured by Hach, or approved equal.

7. The controller shall be a Hach SC200 universal controller.

B. Accessories

Include the following accessories:

1. Bypass panel (flow-through sample cell)
2. Replacement wipers (5)
3. Fixed point installation
4. Calibration kit

ANALYZER – NITRATE AE/AIT-211

GENERAL		
1.	Channel Tag No.	AE/AIT-211
2.	P&ID No.	N-601
3.	Service	Potable Water Nitrate Concentration
SENSOR ASSEMBLY		
4.	Location	Well 8 Pump House
5.	Mounting	Panel
6.	Housing Material	Mfr. Std.
ANALYZER/TRANSMITTER		
7.	Location	Well 8 Pump House
8.	Mounting	Panel
9.	Calibration (mg/L as N)	0-100
10.	Enclosure	NEMA 4X
11.	Power	120 VAC

SERVICE CONDITIONS

12.	Process Media	Potable water
13.	Temp. (deg. F) (min./max.)	50/80
14.	Oper. Pressure (psig) (min./max.)	0/60
15.	Amb. Temp. (deg. F) (min./max.)	20/110

PART 3 - EXECUTION

1. Refer to Section 405000.

2. Manufacturer's representative will include a half-day of start-up services by a factory-trained technician.

   a. Contractor shall schedule a date and time for start-up.

   b. Contractor will require the following people to be present during the start-up procedure.

      (1) General contractor

      (2) Electrical contractor

      (3) Manufacturer trained representative

      (4) Owner's personnel

END OF SECTION

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SECTION 405040 PROGRAMMABLE LOGIC CONTROLLER AND OPERATOR INTERFACE

PART 1 - GENERAL

A. Description

This section includes requirements for materials, testing, and installation of a control system.

B. Related Work Specified Elsewhere

Process Control and Instrumentation System (PCIS) General Requirements: 405000.

C. Submittals

Submit shop drawings in accordance Section 5.22 of the Special Provisions and Section 405000.

PART 2 - MATERIALS

A. Designations of Components

In these specifications and on the plans, all systems and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

B. Programmable Logic Control System

1. A fully integrated programmable logic control system shall be furnished as specified in this section. The programmable logic control system hardware shall be intelligent process control units with analog and discrete I/O for process interface.

2. The a-c power of the control system will be 120-volt ±10% a-c, 60 hertz, single phase derived from line power. The system shall be designed to operate satisfactorily from 0°C to 60°C ambient temperature for the PLC.

C. Programmable Logic Controller (PLC)

1. The PLC shall be a 16-bit programmable logic controller microprocessor-based stand-alone device. It shall be a process and logic controller designed for industrial environments. It shall be capable of a mix of logic, timing, counting, computation, library of preprogrammed subroutines, and PID loop control capabilities necessary for the unit process application. The PLC shall utilize a "prepackaged"/"preprogrammed" approach to functionality to allow its use by personnel who have no formal training in digital equipment, digital communications, or software programming.

2. The PLC shall come complete with chassis, central processor, memory, power supply, interconnecting cables, and discrete and analog I/O interfaces.

3. The logic and variable memory shall be read/write RAM. All RAM shall have integral battery backup that will maintain the memory for a minimum of six months upon a utility power

failure. The logic and variable memory shall have a sufficient ladder logic location for programming all specified functions plus 25% spare memory.

4. The PLC shall have the following features:

   a. Logic Control: The PLC shall be capable of performing the same functions as conventional logic systems including on delay timers, off delay timers, counters, and drum sequencers.

   b. Compare Function: The PLC shall perform the compare function that compares two integers or floating point numbers for less than, equal to, greater than, and not equal to. The programmed function shall energize when true and de-energize it when false.

   c. Move Function: The PLC function shall move an integer or floating point value from one memory location to another memory location when an internal permissive is enabled.

   d. Math Function: The PLC shall be capable of performing addition, subtraction, multiplication, and division on integer or floating point numbers.

   e. Analog Controllers: The PLC processor shall perform all the functions of the conventional three-mode (PID) analog controller. The controller shall perform proportional only control, proportional plus reset, and proportional plus reset plus derivative and integral only control. The controller shall be the conventional three-mode controller.

   f. The PLC shall be able to generate PID loops with a minimum sample time of 1.0 seconds. PID tuning constants shall have the following adjustable range:

Proportional Gain	0.0% to 99.99%
Reset Time	0.01 to 999.99 minutes
Derivative Time	0.00 to 999.99 minutes

   g. Time Proportional Control (TPC): The PLC processor shall be capable of modulating a valve by using time proportional control. When the process variable is above set point, the controller shall pulse a discrete output on/off, closing the valve. When the process variable is below set point, the controller shall pulse a second discrete output on/off opening the valve. When the set point and process variable are equal and within dead band, both discrete outputs shall be off. The controller "on" pulse time shall proportionally increase as the error between process variable and set point increases. A PLC preset cycle timer shall monitor and reset the controller's "on" time intervals. The controller set points shall be accessed via the SCS.

   h. Time-of Day Clock: The PLC shall have an internal time-of day clock/calendar running independently of the CPU.

   i. PLC System Alarm: The PLC processor shall monitor the internal operation of the PLC system for failures. If a failure is detected, the system shall shut down and freeze all inputs and outputs in their last states until the error is cleared. As a minimum, the following failures shall cause the PLC to shut down:

      (1) Memory failure.

      (2) Memory parity error.

(3) I/O cycle failure.

(4) Operating system error.

5. Input/Output:

a. The PLC discrete input modules shall be 24-volt DC or 120-volt AC and have noise filters or use other techniques to reject short-time constant noise and 60-Hz pickup.

b. The PLC discrete output modules shall be 120-volt AC, or 24-volt DC solid-state drivers suitable for operating control relays. Each discrete output module shall include fuses and fuse blown indicators.

c. The PLC analog inputs shall be suitable for accepting 4 mA to 20 mA from either 2- or 4-wire transmitters. The input power shall be from an external 24-volt DC power supply. The analog to digital converter shall have a 12-bit minimum resolution with an overall accuracy of 0.5% at 60 °C.

d. Discrete PLC I/O modules shall have individual LED status lights for each I/O point.

e. All discrete and analog modules shall have terminal blocks for termination of the I/O wires.

f. Individual I/O points shall be capable of withstanding low energy common mode transients to 1,500 volts.

6. Spare I/O

a. Provide the following minimum spare I/O:

(1) Analog Inputs: One complete module.

(2) Analog Outputs: One complete module.

(3) Discrete Inputs: One complete module.

(4) Discrete Output: One complete module of each type.

b. Pre-wired Spare I/O: provide PLCs with the minimum unused 50% of total pre-wired I/O for future facility expansion. PLC chassis should at least have three empty slots.

7. Each PLC shall be able to communicate to an Ethernet network.

8. The PLC shall be Automation Direct Productivity series PLC, no “or equal” is acceptable.

D. PLC Software

1. All PLC programming shall be in ladder logic using a standard Windows-based package developed for this purpose.

2. All programming, monitoring, searching, and editing shall be accomplished with the PLC programming software. The programming software shall be usable while on-line, off-line, and shall have the ability to emulate/run the PLC program using the programming unit. The PLC program shall display multiples of series and parallel contacts, coils, timers, counters, and mathematical function blocks. The software shall be able to monitor the status of all

inputs, outputs, timers, counters, and coils. It shall have the capability to disable/force all inputs, outputs, and coils to simulate the elements of the ladder logic by means of color change. The software shall include a search capability to locate any address or element and its program location. PLC status information, such as error indication and amount of memory remaining shall be shown on the display screen.

E. Operator Interface (OI)

1. Provide, program, test, fully configure, and place into operation Operator Interface as indicated herein.

2. The operator interface shall be a panel mounted electronic assembly that allows bi-directional communication with a programmable logic controller.

3. The OI shall be a TFT-type and have touch screen capability. The unit shall employ flash memory for storing the application specific symbols and data. The unit shall be capable of handling up to 160 touch areas per screen display and a minimum of 50 screens. Each touch area shall provide audible feedback to the operator.

4. The unit shall meet the following requirements:

   a. Size: 8-in diagonal (nominal)

   b. Display View: 7.5-in diagonal, minimum

   c. Resolution: 640 x 480 pixel, minimum

   d. Brightness: 300 nits, minimum

   e. Ambient temperature rating: 50°C for outdoor installation

5. Screens shall be configured using an off-line PC based software package that operates in the Windows environment. Configuration software shall be provided.

6. Each display screen shall consist of graphic representations of legend plates, push buttons, pilot lights, numeric data displays, numeric data entry buttons, bar graphs, time displays, text displays, selector switches, illuminated push buttons, counter/timer numeric preset and increment/decrement buttons. Graphics can be created using any software that produces standard BMP files. Applications shall be downloaded to the operator interface device and stored in flash memory.

7. The unit shall be capable of displaying text messages that can be triggered by the status or values of bits or numeric variables in the programmable logic controller. In addition, the unit shall be capable of accepting and displaying text messages that are stored in programmable controller as ASCII strings.

8. Graphics: The operator shall monitor and control the system using a number of pre-configured graphic displays, which represent the particular equipment and processes being controlled. Minimum of five screens shall be programmed for each process unit shown on a single P&ID. Graphic displays shall be provided illustrating a process flow using symbols to represent equipment with process flow direction lines connecting the symbols. Symbols shall be used for pumps, motors, valves, and primary elements. Adjacent to each discrete graphic symbol, the description shall be included. Adjacent to each analog graphic symbol, the point description, current value, and engineering units shall be displayed. Alarm messages shall flash. All process lines, structures, and equipment shall be identified with

the proper nomenclature. The process and instrumentation diagrams (P&IDs) provided under these specifications shall be used to help generate graphics displays.

9. The OI shall communicate with the programmable logic controller in a fashion, as determined by the PLC manufacturer. A communication driver shall be provided with the editing software.

10. All cables for communication between the unit and the PLC shall be provided along with a cable for serially interfacing the device with a personal computer.

11. OI shall be C-more by AutomationDirect, Maple Systems, EZSeries by EZAutomation, or equal.

F. Ethernet Switch (copper ports)

1. Ethernet switch shall be DIN-rail mountable. Ethernet switch shall be in full compliance with standards set forth by IEEE 802.3. Switch shall have five Ethernet ports, as minimum. LEDs on each port shall indicate link data rate and activity status. A power LED shall indicate that power is applied to the.

2. Ethernet Switch shall meet the following specific requirements:

   a. Operation: 10/100 Mbps, Full and Half Duplex, Auto-Negotiation

   b. Switching Properties: Store & Forward

   c. Number of MAC addresses: 1024

   d. Up to 1.0 Gb/s Maximum Throughput

   e. Minimum of 64K of message memory

   f. Interface: RJ-45 10/100BaseTX ports

   g. MDIX Auto Cable Sensing

   h. Operating Temperature: -20°C to 60°C

   i. Operating Humidity: 10% to 95% (noncondensing)

   j. MTBF: 100,000 hours minimum

3. The Ethernet switch shall be Phoenix Contact FL SWITCH SFNB 5TX, Moxa Technologies Mod. EDS-205, or equal. .

G. Signal Isolators/Splitter

1. Signal isolators shall provide complete isolation of the input, output and power circuits. Analog input isolators shall be optical isolators and shall be mounted in the same cabinet as the analog input module. Signal input shall be 4-20 mA into 50 ohms maximum; signal output shall be 4-20 mA into 250 ohms minimum. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to ensure sufficient power to each loop component. Loop powered signal isolators are not acceptable. Signal voltage may be 120VAC or 24VDC as supported by the design. Accuracy shall be ±1 percent of

span. Units shall be surface or rack mounted. Signal isolators shall be Moore Industries Model ECT-DIN, or equal.

H. UPS

1. Provide a UPS to protect the PLCs, instruments, and communication system from line disturbance, subcycle power losses, brownouts, blackouts, or general power outages. In normal operation the UPS shall supply filtered and regulated AC power to the load. Upon failure of the commercial AC power the critical load shall continue to be supplied by the inverter, which shall obtain its power from the battery.

2. There shall be no interruption of the output waveform to the critical load upon failure or restoration of the commercial AC source. Upon restoration of the commercial source, the inverter/charger shall recharge the battery.

3. The UPS shall have a built-in battery test feature to periodically test the battery with actual load connected. During the test the load power shall be derived from the inverter. There shall be no power interruption to the load, if the battery test fails.

4. The UPS shall be complete with the following features:

   a. Power indication.

   b. “Common Alarm” discrete output.

   c. “UPS on Battery” discrete output.

   d. Inverter circuit breaker protection.

5. The UPS system shall meet the following requirements:

   a. Input/output voltage: 120-volt AC, single phase, 60 Hz.

   b. Output harmonic distortion: 5% maximum at full load.

   c. Frequency stability: ±0.5%.

   d. Voltage regulation for line and load: ±3%.

   e. Overload capacity: 125% for 10 minutes.

   f. Battery lifetime: 3 years at ambient temperature 40°C.

   g. Operating Temperature: 0°C to 40°C.

   h. Batteries: Internal

   i. Output rating: 500 VA.

   j. Battery Backup Time: 9 minutes (at full rated load).

6. UPS shall be manufactured by Allen-Bradley Cat. No. 1609-D600-NH or equal.

I. Spare Parts

1. The Contractor shall furnish to the Owner all necessary spare parts of components required to maintain the system. Prior to final acceptance of work, the Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the Owner's Representative. The spare parts shall include the following minimum requirements:

No.	Part Description	Quantity
a.	PLC Power Supply	1 each
b.	CPU and Memory Module	1 each
c.	Analog Input Module	1 of each type
d.	Discrete Input Module	1 of each type
e.	Analog Output Module	1 of each type
f.	Discrete Output Module	1 of each type

2. The Contractor shall deliver to the Owner all the required spare parts upon final acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee period.

PART 3 - EXECUTION

Refer to Section 405000.

END OF SECTION

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SECTION 405080 INSTRUMENT CONTROL PANEL (ICP)

PART 1 - GENERAL

A. Description

This section includes requirements for materials, testing, and installation of the cabinets and consoles to be provided by the system contractor under Section 405000.

B. Related Work Specified Elsewhere

Process Control and Instrumentation System (PCIS) General Requirements: 405000.

C. Submittals

Submit shop drawing in accordance with Section 5.22 of the Special Provisions.

PART 2 - MATERIALS

A. Free-Standing Instrument Control Panel

1. The panel shall be a floor-mounted NEMA 12 enclosure and shall be constructed from 14-gage formed steel throughout. Access door shall have door bars on inside surface and continuous hinges. All exposed edges and welds on the enclosure shall be ground smooth. No penetration through the cabinet door or exterior with rivets, screws, bolts, or back of panel nuts shall be allowed. The enclosure shall provide protection against dirt, dust, oil, and water. The interior shall be provided with a formed 12-gage subpanel for attaching surface-mounted components. All components shall be attached with screws, and the subpanel shall be threaded.

2. Rivets or back of panel nuts, screws, or bolts shall not be allowed. No panel penetration is allowed, except for the conduit entry.

3. Provide an LED lamp in the panel. Each interior shall be equipped with a 120 V, 20 A duplex utility outlet and a dedicated single-pole, 20 A, 120 V circuit breaker protecting the outlet and the lamp. The utility outlet and the lamp shall be powered by utility power.

4. Power distribution system shall include a UPS to be powered from a designated "UTILITY POWER FOR UPS" receptacle. The power distribution system shall be connected to the UPS output by a cord with a plug matching the UPS outlet. Provisions shall be made to allow the UPS to be bypassed, i.e. power distribution system to be powered from the utility power by the power cord connected to the "UTILITY POWER FOR UPS" receptacle. The receptacle shall be protected by a designated circuit breaker.

5. A folding shelf at least 18 inch wide and a documentation pocket shall be provided at the panel. The shelf shall be secured to the door bars in a way to allow vertical adjustment of the shelf location.

6. Refer to instrument drawings for enclosure minimum size and installation details.

7. Temperature Control:

   a. Contractor shall provide temperature control features, to maintain internal cabinet temperature within the limits required by the equipment installed in the cabinet.

   b. Submit cooling system sizing calculations, as part of the enclosure submittal. For each panel submit a spreadsheet to list heat loss and temperature limit for each component.

8. Assume ambient temperature of 115°F. The enclosure shall be customized Hoffman NEMA 4 Quote #1012042, or equal.

B. Panel Control Circuit Devices and Components

1. General: All components, except those on the front panels, shall be mounted behind on fixed or swing-out panels; terminal blocks for field connections shall be mounted on fixed channels located near the bottom of the sections but clear of the conduit entry area. Fixed panels shall be located so as not to prevent access within the cabinets to other components, wiring, and terminal blocks on fixed panels or front panels.

2. All electrical devices within the panel shall be identified by tag number, machine printed on a label visible from the panel interior. Labels shall be made of durable plastic tape with an adhesive backing. The labels shall have rounded corners and shall be consistent in size throughout the panel.

3. Control Relays:

   a. Control relays shall have 120-volt AC or 24-volt DC coils, except as noted; contacts shall be rated for the various circuit applications shown on the drawings. Control relays shall be 10-ampere, multiple-contact, 300-volt, plug-in type with dust cover and sockets. The relays shall be equipped with the following features:

      (1) Retaining clip.

      (2) Test button lockable in "ON" position.

      (3) Mechanical flag for contact status indication.

      (4) Pilot light for coil power indication.

   b. If additional contacts are required, they shall be ganged.

   c. The relays shall be Releco General Purpose Relays, Allen-Bradley Bulletin 700-HA, IDEC series RU, Telemecanique RXM relay (Zelio Plug-in), or equal. All control relays shall be products of one manufacturer.

4. Circuit Breakers: Circuit breakers shall be single-pole, 120-volt, 15-ampere rating.

5. Feed-Through Terminal Blocks: Feed-through terminal blocks shall be modular DIN rail mounted with plastic insulating housings and screw secured cage clamp wire termination and shall be rated 20 amperes at 300 volts. Current carrying parts shall be made of at least an 85% copper alloy, nickel-plated for maximum conductivity and resistance to corrosion. Terminal blocks shall provide a secure oxide-film free connection to the wire without the use of spades, ring tongues, or ferrules. Terminals blocks shall have captive screws and a built-in vibration resistance mechanism, which locks the screw connection in place after the wire

has been terminated. A bridge bar for cross connection shall be provided. A test adapter for a banana jack shall be provided. The test adapter shall provide a positive test connection to the terminal block and shall lock into place for hands free operation. White marking strips, fastened securely to the molded sections shall be provided and wire (terminal) numbers or circuit identifications shall be marked thereon with permanent marking fluid. Feed-through terminal blocks shall be Phoenix Contact Type UK 4, Allen-Bradley Series 1492-W, ABB (Entrelec) Series M4/6.NC, Sprecher+Schuh Cat. No. V7-W4, or equal.

6. Fuse Terminal Blocks: Fuse terminal blocks shall be the same profile, but different color as the feed through terminal blocks, and shall have blown fuse light indicator. Fuse terminal blocks shall be Phoenix Contact Type UK 4-TG, or equal.

7. Disconnect Terminal Blocks: Disconnect terminal blocks shall be of knife disconnect type. The blocks shall have a universal foot for mounting on DIN rail and a width of the feed through block. Disconnect terminal blocks shall be Phoenix Contact Type UK 5-MTK-P/P, or equal.

8. DC Power Supplies: Provide DC power supplies as required for analog loops and DC circuits. Each power supply shall be enclosed and include internal short-circuit protection. Current requirements shall not exceed 75% of manufacturer maximum rating.

9. Receptacles: Duplex receptacles shall be molded composition, ivory, specification grade, with finder groove face. Duplex receptacles for 120-volt, single-phase, 3-wire service to be rated 20 amperes, 125 volts, back or side wired, NEMA Type 5-20R. Duplex receptacles shall be Arrow-Hart No. 5352I, Bryant No. BRY5362-I, Hubbell No. HBL5362-I, or equal.

10. Indicating Lights: Indicating light shall be push-to-test transformer type with LED.

C. Panel Control Circuit Wiring

1. Wire Type and Size:

a. Instrumentation signal cables carrying analog signals shall be of the type used for process control with shielded twisted pairs or triads with polyvinyl jacket and overall shield over the multiple pairs or triads. The instrumentation cable shall be rated 300 volts at 90 °C or better. The size of the instrumentation cable shall be AWG No. 18 with seven strands minimum, unless otherwise specified elsewhere. All instrumentation cables shall meet all the requirements of IPCEA and shall be UL listed.

b. 120-volt AC wiring within the panel shall be AWG No. 14 THHN. Main power (120-volt AC) to the panels shall be wired using color coded AWG No. 12. AC power to all system power supplies. Wires shall be color coded in accordance with the following table:

Black	L1 (hot)
White	L2 (neutral)
Red	AC control circuits
Blue	DC circuits
Yellow	Interlock control circuits wired from an external power source
Green	Equipment ground

2. All interfacing between the cabinets and the field shall be accomplished at a terminal strip (TB-1). No internal panel wiring shall be connected to terminals on the "field side" of TB-1. Likewise, no field wiring shall be connected to terminals on the "panel side" of TB-1.

3. All intentionally grounded, grounding, and bonding conductors shall be sized by NEC Article 250 as required.

4. Wires carrying voltage from external devices and one wire from an analog loop shall be terminated at the disconnect terminal block.

5. Only one wire shall be terminated at each side of a terminal block. A bridge bar shall be used for cross connection.

6. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These 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 terminals.

7. Wiring run to control devices on the front panels shall be tied together at short intervals and secured to the inside face of the panel using Panduit adhesive mounts with Eastman No. 910 adhesive.

8. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

9. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer's review.

10. Signal conditioners and control interface relays shall be provided wherever proper instrument interfacing dictates use of these components. Each auxiliary device shall be assigned a tag number and shall appear on the panel shop drawings.

11. Wire Marking:

    a. Each signal and 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.

    b. For field distribution of a common potential, wire number to each field device shall consist of a common (group) number and individual number, ex. if a wire connected to a “hot” potential on a panel side of a terminal block has tag “5”, then field wires should be tagged “5-1”, 5-2”, etc.

    c. The markers shall be permanent sleeve type with machine printed black markings. Markers shall be Thomas & Betts Series EZS, Tyco Series RPS, or equal.

12. Terminal Marking: Each terminal shall be identified by a single unique number. Hand-written labels shall not be allowed. The match between the terminal identification and the wire identification is not required.

13. All electrical devices within the panel shall be identified by tag number, machine printed on a label visible from the panel interior. Labels shall be laminated plastic with an adhesive backing. The labels shall be consistent in size throughout the panel.

D. Spare Parts

1. The Contractor shall furnish to the Owner all necessary spare parts of components required to maintain the system. Prior to final acceptance of work, the Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the Owner's Representative. The spare parts shall include, but not be limited to, the following minimum requirements:

MINIMUM SPARE PARTS LIST	
Part Description	**Quantity**
1. Power supply	1 each type
2. Relays	2 each type

2. The Contractor shall deliver to the Owner all the required spare parts upon final acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee period.

PART 3 - EXECUTION

Refer to Section 405000.

END OF SECTION

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SECTION 409210 ELECTRIC MOTOR ACTUATORS FOR VALVES

PART 1 - GENERAL

A. Description

This section includes materials and installation of electric motor actuators for valves.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.

2. Manual, Check, and Process Valves: 400520.

3. Pipe Hangers and Supports: 400764.

4. Equipment, Piping, Duct, and Valve Identification: 400775.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data showing motor actuator parts and materials of construction, referenced by AISI, ASTM, SAE, or CDA specification and grade. Show motor actuator dimensions and weights. Identify each valve and actuator combination by tag number to which the catalog data and detail sheets pertain. Show coatings.

3. Show the maximum torque required to open and close each motor-actuated valve.

4. Submit certified factory performance test records.

5. Submit motor data including nameplate data, insulation type, duty rating, and torque output at duty rating.

6. Submit electrical schematic drawings and wiring diagrams showing physical locations of components.

PART 2 - MATERIALS

A. Actuator Identification

1. Motorized valves are identified in the drawings by valve number and suffix letter "M." For example, a callout in the drawings of V009M indicates that valve V009 is equipped with a electric motor actuator.

2. Motor actuators shall have the name of the manufacturer cast or molded onto the actuator body or shown on a permanently attached plate in raised letters.

B. Actuator Tagging

Provide identifying tags for electric motor-actuated valves per Section 400775. Show valve actuator tag number, name or designation as shown in the drawings, and valve size. Attach tags to actuators by means of stainless steel or copper wire.

C. Actuator Designations and Designs

Actuator designations consist of a type number (1, 2, or 3) and one or more suffix letters (see Part 3.A, below). The number and the letters are intended to be compatible and the actuator shall meet the requirements of all.

Suffix	Description
None (basic design)	15-minute duty cycle; NEMA 4 enclosure (motor, controls, push buttons); open-stop-close operation; 120-volt, 60-hertz, 1-phase power supply (Type 3 actuators); valve to remain in last position upon loss of control signal. Any of these basic requirements may be modified or superseded by suffixes (described below).
A	30-minute duty cycle.
B	NEMA 4X enclosure (motor, controls, push buttons).
O	Valve closes upon loss of control signal.
P	Valve incorporates a spring return to close upon loss of power.
S	200-230-volt, 60-hertz, single-phase, a-c power supply.
V	Position transmitter with 4- to 20-mA output signal.

Thus, an actuator designated as “Type 3BP” would be a Type 3 motorized actuator and have all the requirements described and specified for those suffix letters.

D. Actuator Torque Requirements

1. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

2. Maximum torque shall include seating or unseating torque, bearing torque, dynamic torque, and hydrostatic torque. Assume that the differential pressure across the valve is equal to the pressure or head rating of the valve.

3. Assume a maximum pipeline fluid velocity of 16 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

E. Design of Type 3 Electric Motor Actuators

1. Output capacity of motors shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Each electric actuator shall be bidirectional type with

permanent split capacitor motor drive. Provide motor brake for positive stopping and to prevent movement when power is off. Provide built-in motor thermal overload protection. The control housing shall be NEMA 4 construction unless otherwise specified. Motors shall have Class F or H insulation system. Provide motor with torque output (at duty rating) that exceeds the requirements of the following paragraphs including safety factor.

2. Design the actuator to move valves from fully closed to fully open in no more than 60 seconds.

3. Provide a local-off-remote selector switch, stop-open-close push buttons, and open and closed indicator lights.

4. Provide a separate (remote) enclosure or control station with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6 feet above floor or deck in lieu of integral controls or where indicated in the drawings.

5. Do not use external conduit for wiring any components within the actuator.

6. Gear actuators shall be totally enclosed and factory-grease packed or oil lubricated. The power gearing shall consist of a combination of planetary, worm, and helical gears and shafts of heat-treated steel. Worm shall be hardened steel alloy. Design gears for 24-hour continuous service with an AGMA rating of 1.50.

7. Position switches shall be integrally geared to the actuator and shall be adjustable. Provide motor actuators with position switches to stop motion at the end of travel in each direction.

8. Provide auxiliary switch contacts for transmitting open and close position.

9. Provide two separate 3/4-inch conduit connections for control and power wiring.

10. Provide two individually adjustable torque switches to protect the valve and motor against overload in the opening and closing directions. To prevent hammering, the torque switch shall not reclose until the valve is made to travel in the opposite direction.

11. Provide a manual override to allow operation of valve in case of power failure. Provide disengageable manual override so that the actuator cannot be operated electrically while the manual override is engaged.

12. Provide a space heater mounted in the actuator housing. Heater shall be on at all times.

13. Provide terminal connections for external remote controls fed from an internal 24-volt or 120-volt supply.

14. Electric motor actuators shall be Bettis Series EM-800, EL-O-Matic Series EL or ELD, or equal. Type 3 actuators on the project shall be of one manufacturer.

PART 3 - EXECUTION

A. Service Conditions

Valve Tag Number	Actuator Type or Designation	Fluid	Max. Flow (gpm)	Max. Dif. Press. (psi)	Opening/ Closing Time (seconds)	Separate (Remote) Control Enclosure Required?
BFV1	Type 3	Water	1,500	70	60	No
BFV2	Type 3	Water	1,500	70	60	No

B. Factory Performance Testing of Motor Actuator

Test each actuator prior to shipment in accordance with AWWA C542, Section 5.3. The application torque shall be the maximum torque required to open or close the valve at any position including seating and unseating conditions.

C. Painting and Coating

Coat electric motor actuator the same as the valve to which it is attached. If the valve is not coated, coat actuator per Section 099000, System No. 15. Apply the specified prime, intermediate and finish coats at the place of manufacture. Color of finish coat shall match the color of the valve to which the actuator is attached. If the actuator is attached to a submerged valve or to an uncoated valve, color of finish coat shall match the color shown in the Piping Schedule in the drawings for the particular piping service.

D. Shipment, Storage, and Temporary Installation Before Start-Up

1. Prepare equipment for shipment per AWWA C542, Section 6.2 and the following. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

2. Identify the equipment with item and serial numbers and project equipment tag numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number and project equipment tag numbers of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

3. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

4. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

5. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of manufacture prior to shipping.

6. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

7. If actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the actuator electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Exercise each actuator from its fully open to fully closed position at least once every seven days. Inspect electrical contacts before start-up.

E. Floor Stands and Extension Stems

Where shown in the drawings, mount the electric motor actuators on floor stands with extension stems as specified in Section 400520.

F. Attaching Electric Actuators

The valve manufacturer shall mount the electric motor actuator and accessories on each valve and stroke the valve prior to shipment. Adjust limit switch positions and torque switches.

G. Field Installation

Install the valve and actuator as indicated in the drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

H. Field Testing of Motor Actuators

1. Test motor actuators as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions. The measured current shall not exceed the current measurement recorded during the factory performance test.

2. If the measured current drawn exceeds the above value, provide a larger motor or gear drive or adjust the actuator so that the measured amperage does not exceed the value.

3. Assure that limit switches are placed at their correct settings. Open and close valves twice and assure that limit switches function.

END OF SECTION

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SECTION 409715 PRESSURE GAUGES AND PRESSURE SWITCHES

PART 1 - GENERAL

A. Description

This section includes materials and installation of pressure gauges, pressure switches, and accessories.

B. Related Work Specified Elsewhere

1. Pressure Testing of Piping: 400515.

2. Manual, Check, and Process Valves: 400520.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and descriptive literature. Call out materials of construction by ASTM reference and grade. Submit manufacturer's certificate of compliance with the referenced ANSI standards.

PART 2 - MATERIALS

A. Pressure Gauges

1. Pressure range shall be as designated by the following type numbers shown in the drawings:

Type Number	Description	Pressure Range
3	Pressure	0 to 30 psi
4	Pressure	0 to 60 psi
5	Pressure	0 to 100 psi
6	Pressure	0 to 150 psi

2. If no type number is shown in the drawings, use Type 5 gauges.

3. Types 3 Through 7: Gauges 4 1/2 inches and larger shall comply with ASME B40.100, Grade 2A. Gauges shall incorporate the following features:

   a. Solid or open front with side or rear blowout relief.

   b. Pressure tight.

   c. 270-degree arc with adjustable pointer.

   d. Stem mounted.

   e. Hermetically sealed unless specified to be liquid filled.

Size of gauge shall be 4 1/2 inches, unless otherwise indicated in the drawings. Stem or connection size shall be 1/2 inch.

4. Types 3 Through 6: Gauges smaller than 4 1/2 inches shall conform to ASME B40.100, Grade A. Otherwise, construction shall be as described above.

5. Materials of construction for Types 3 through 6 gauges shall be as shown in the following table:

Item	Material	Specification
Case	Stainless steel, aluminum, polypropylene, or phenolic plastic	AISI 316, 6061-T6
Bourdon tube	Stainless steel	AISI 316
Windows	Acrylic plastic	---
Ring	Stainless steel	AISI 316
Stem	Stainless steel	AISI 316
Dial face	Aluminum with clear baked-on acrylic coating	ASTM B209, 6061-T6

B. Pressure Switches

1. Pressure switches shall be Type 316 stainless steel bourdon tube type actuating an enclosed, metal contact snap-action switch. Switch shall have separate set point and reset point adjustments. Pressure switch range and number of switch contacts shall be as indicated in the drawings. Provide the assembly with an indicating scale to show the trip setting of each switch. Provide Mercoid Series N3-DAW, United Electric H400 series, Ashcroft L series, or equal.

2. Differential pressure switches shall be as described above and shall have opposed-bellows type actuating an enclosed metal contact snap-on switch upon increase of pressure difference. Switch shall have double external adjustment. Provide Mercoid Series DPAW or equal.

C. Pipe Nipples and Fittings

Nipples for connecting gauges to piping shall be Schedule 80S, Grade TP 316 seamless stainless steel, conforming to ASTM A312. Fittings shall conform to ASTM A403, Class WP316. Threads shall conform to ASME B1.20.1. Size of pipe nipple shall match the gauge connection size.

D. Gauge Cocks

Gauge cocks shall be two way. Gauge cocks shall be per Section 400520.

PART 3 - EXECUTION

A. Installation

Install gauges and pressure switches before conducting pressure tests. Do not disassemble gauges from the factory-assembled diaphragm seals or isolation sleeves or rings.

END OF SECTION

SECTION 432102 MECHANICAL SEALS AND PACKING FOR PUMPS

PART 1 - GENERAL

A. Description

This section includes materials, application, and installation of packing for vertical turbine pumps. See the detailed pump specifications for the specific type of seal or packing to be provided.

B. Related Work Specified Elsewhere

Vertical Turbine Pumps--Water Wells: 432154.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit manufacturer's catalog data and detail drawings showing packing type and material and mechanical seal design and parts. Describe material of construction by specification (such as AISI, ASTM, SAE, or CDA) and grade or type.

PART 2 - MATERIALS

A. Type "I": Packing Sealing System

1. Provide five rings (minimum) of packing plus a lantern ring and repacking space. Provide grease lubrication. Packing shall be one of the following nonasbestos materials:

a. Regular braid, square cross-section graphite-lubricated, and impregnated nonasbestos packing, such as Garlock Style 8909, Phelps Style 2075, or equal.

b. Teflon-impregnated nonasbestos packing with lubricant, such as Phelps Style 2072, Garlock Style 8922, or equal.

PART 3 - EXECUTION

Install per pump manufacturer's recommendations.

END OF SECTION

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SECTION 432154 VERTICAL TURBINE PUMPS--WATER WELLS

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of vertical turbine pumps for water well service.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.

2. Electric Motors: 262650.

3. Variable Frequency Drive (VFD): 262923.

4. General Piping Requirements: 400500.

5. Equipment, Piping, Duct, and Valve Identification: 400775.

6. General Requirements for Steel Piping: 402001.

7. Mechanical Seals and Packing for Pumps: 432102.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit dimensional drawings.

3. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings.

4. Submit pump manufacturer ISO 9001 certification per Article 2.01A. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.

5. Show shaft diameter and bearing spacing. Submit calculations showing shaft critical frequency and determination of bearing spacings. Show calculated bearing life.

6. Submit pretest pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Include moment of inertia of the complete pumping unit including driver, impeller, and liquid pumped. Show required submergence and NPSH.

7. As part of the field test procedure for the pumps, record measurements for impeller adjustment at the top of the shaft and total radial shaft deflection (shaft runout) above the packing box.

8. Submit manufacturer's sample form for reporting performance test results at least two weeks before the tests. The test form should contain the data presented in ANSI/HI 14.6.

9. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, torque, brake horsepower, pump efficiency, required submergence, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.

10. Submit report on results of factory resonance test and modal shape signature results.

11. If pump is tested with job motor, do not correct test results for speed. If factory motor is used, correct speed to that indicated for the job motor as determined by motor factory test.

12. Submit motor data per Section 262650.

D. Definitions

1. Terms shall be as defined in the Hydraulics Institute Standard ANSI/HI 2.1-2.2 for vertical pumps.

2. Additional terms are defined below:

Submergence: Vertical distance in feet between the pumping water level and the bottom of the suction bell.

E. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One labor day for each service listed in the subsection on "Service Conditions" to check the installation and advise during start-up, testing, and adjustment of the equipment.

2. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

PART 2 - MATERIALS

A. Pump Design

1. All equipment for the pumps, including discharge heads, shafting, columns, motors, bases, and anchor bolts, shall be provided as a complete unit by the pump manufacturer in an ISO-9001-certified facility or by a pump manufacturer accepting warranty responsibility for the complete pump unit. Pump units assembled by entities other than the pump manufacturer will not be acceptable.

2. Each pump shall be capable of at least a 10% head increase at normal operating conditions by installing a larger impeller or an impeller of different hydraulic design.

3. The following criteria shall be used for pump selection:

a. Bowl diameter shall allow for installation in the well casing as constructed.

b. Pump head shall continuously decrease with increasing flow.

c. Pump shall be of current manufacture. Pump characteristic curves are to be included in pump manufacturer's catalog.

4. Pump curve shall be continuously rising and shall be free of dips and valleys from the design point to the shutoff head. The shutoff head shall be at least 120% of the head that occurs at the design point.

5. The NPSH required shall be at least 10 feet less than the minimum NPSH available at all points on the pump curve up to 115% of the flow at the BEP.

6. Design the pump and its components to operate continuously over a preferred operating range (POR, as defined in ANSI/HI 9.6.3-2017) of 65% to 115% of the flow at the BEP.

7. Motor operating speed range for designing discharge head for reed critical frequency shall be 1,200 to 1,800 rpm.

B. Motors

1. Motors shall be vertical high thrust-hollow shaft. Motors shall be as further described in the subsection on "Service Conditions."

2. The driver motor thrust bearing loading shall include the total pump lineshaft downthrust. Design the motor bearings to withstand any momentary total upthrust equivalent to at least 30% of the maximum downthrust developed.

C. Couplings and Coupling Guards

Provide a threaded coupling. Provide coupling guards conforming to CAL/OSHA requirements.

D. Discharge Assembly

1. Provide a discharge assembly for surface discharge. The discharge assembly shall have bolted register or rabbet-fit connections for the motor. Discharge assembly shall have connections for the pump column and discharge piping and shall support the loadings that they impose as well as contain the pump pressure.

2. Design columns and discharge assemblies for 150% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff.

3. Access to the stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes and/or windows with Type 304 stainless steel expanded metal guards per CAL/OSHA requirements. Provide hinged or removable Type 304 stainless steel guards.

4. Design discharge assembly to be aesthetically compatible with the mounted motor and with adjacent pumping units. Where the motor is smaller in horizontal dimension than the discharge pipe, shape a skirt to transition between the two masses. Where the motor is larger than the discharge assembly, a skirt of approximately motor diameter dimension shall enclose the discharge assembly to provide an adequate-appearing motor support.

5. The discharge shall be flanged, having a pressure rating as shown in the subsection on "Service Conditions."

   a. Class 125 or 150 flanges shall comply with AWWA C207, Class D.

   b. Flanges shall be flat face.

   c. Groove welds shall be full penetration welds. Fabricated flanges shall be welded both inside and out.

6. Provide for lifting the heads by means of lifting eyes that are capable of sustaining the weight of the complete unit less the motor.

E. Seal Chambers or Stuffing Boxes for Open Lineshaft Pumps

The design of the stuffing boxes shall provide space and clearance for removal and service for Type I packing per Section 432102 without moving or disconnecting the motor.

F. Lubrication

Pumps shall have open lineshafts as shown in the subsection on "Service Conditions." Open lineshaft pumps shall be self-lubricated.

G. Column Pipe

1. The column pipe joints shall be flanged and bolted to the discharge assembly and to the pump bowl assembly, and shall have register fits at each end. Material shall be as listed in the subsection on "Pump Materials of Construction."

2. Top and bottom column pipe sections shall not exceed 5-foot length.

3. Column pipe joints shall be flanged for columns 6 inches and larger and threaded or flanged for smaller sizes.

H. Shafts

1. Support the shafting by bearings at intervals so that the first natural frequency of the rotating assembly is at least 30% above the maximum operating speed. Provide an additional bearing retainer just below the head for added support. Calculate and size the shaft diameter for the pump shutoff head.

2. For metal or rigid bearings, support the shafting at intervals per API 610, paragraph 9.3.6, with a maximum spacing of 5 feet.

3. For pumps having operating speeds 1,800 rpm and less with water-lubricated neoprene bearings, the bearing spacing for the intermediate columns shall not exceed 10-foot lengths. The bearing spacings for the top and bottom column sections shall not exceed 5 feet.

4. For pumps having operating speeds greater than 1,800 rpm and not exceeding 3,600 rpm, support the shafting by bearings at intervals per API 610, paragraph 9.3.6, with a maximum spacing of 5 feet.

5. Tolerance on the shaft diameter through the stuffing box or seal chamber shall not exceed 0.002-inch TIR. Shaft runout on the stuffing box or seal chamber face and at the impeller shall not exceed 0.002-inch full indication movement. The shaft stiffness shall limit the total deflection under the most severe dynamic conditions over the allowable operating range of the pump, with the maximum impeller diameter installed, to 0.002 inch at the primary seal faces or at the stuffing box faces.

6. Shafts and sleeves shall be machined and finished per API 610, paragraph 8.3.3. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design. Threaded couplings may be used for shaft diameters 1 15/16 inches or smaller. Thrust rings, capscrews, and keys where used shall be Type 410 stainless steel.

7. Provide lineshafting with hardened sleeves under neoprene bearings per API 610 (12th edition).

I. Bowl Assembly

1. Each bowl assembly shall consist of the bowl, impeller and impeller shafting, and bearings. Bearings shall be located above and below the impeller. Bearings (other than sleeve type) shall have an AFBMA L-10 life of at least 20,000 hours at any specified flow condition, excluding the shutoff head. Impellers shall be dynamically balanced.

2. Pump bowls shall be of the material listed under the subsection on "Pump Materials of Construction." Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment and to maintain the running clearance of wear rings. Bowls shall be flanged with male and female rabbets or registers for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips.

3. Provide the bowls with a renewable wear ring adjacent to the impeller, made of stainless steel or bronze as indicated under "Pump Materials of Construction." Wear rings and running clearances shall not exceed 0.002-inch clearance per inch of diameter.

J. Suction Manifold

The suction manifold shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The suction manifold inlet shall be flanged with a 10-foot section of column pipe and cone strainer attached.

K. Impellers

Pump impellers shall be of the enclosed type made of the material listed in the subsection on "Pump Materials of Construction" and shall be cast in one piece. Machine to fit the contour of the bowl and hand file in the waterways. Equip with replaceable wearing rings or wearing-ring hubs for mounting wear rings in future repair cycles. Attach impellers to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation. Provide for adjustment of the axial position of the impeller at the motor connection to the head shaft so that proper clearance between bowls and impellers may be maintained.

L. Vibration and Residual Unbalance

1. The maximum vibration level shall not exceed that shown in Figure 9.6.4.2.5.1b in ANSI/HI 9.6.4. Maximum residual unbalance in impellers shall not exceed a balance quality grade of G6.3 per ISO Standard 1940/1.

2. At any operating speed, the ratio of the pump’s natural reed frequency to the rotating speed (f/N) shall be less than 0.8 and greater than 1.3. A factory resonance test shall demonstrate the motor/discharge head structure’s natural reed frequency. Obtain a modal shape signature with an FFT analyzer and submit to Owner’s Representative for review.

3. The Contractor shall require that the pump manufacturer select the appropriate analytical method to determine the critical speed and resonant frequencies of the pump system as described in ANSI/HI 9.6.8-2014. At a minimum, the pump system shall include the bowls, impellers, lineshaft diameters, lineshaft bearing spacing, column diameter and wall thickness, the design of the discharge stand or motor stand with discharge nozzle, and the baseplate and soleplate dimensions (length, width, and thickness).

M. Torsional Analysis

Perform a torsional analysis per API 610 (12th edition) on pumps having: (1) an electric motor driver 600 horsepower and larger, (2) an engine driver 300 horsepower and larger, or (3) any variable speed pump having a driver 75 horsepower and larger. For the purposes of design, a dangerous critical speed shall be defined as one that produces a torsional stress exceeding 3,500 psi.

N. Pump Materials of Construction

1. Materials of construction shall conform to the requirements listed below. Materials of construction for components not listed below shall conform to API 610-2010, Annex H, Material Class I-2.

Component	Material
Pump head shaft and couplings	Stainless steel, ASTM A276, Type 316 or 410.
Lateral bowl wear ring	Neoprene ring reinforced with embedded steel core or aluminum bronze wear rings.
Enclosed line shaft tube stabilizers	Steel, ASTM A36; or ASTM A283, Grade A, B, or C.
Bearing retainers (insert type)	Bronze; see paragraph C below.
Lineshaft bearings	Neoprene for open lineshaft; bronze for enclosed lineshaft.
Impellers	Bronze; see paragraph C below.
Impeller wear ring	Stainless steel, ASTM A743, Grade CF-8M or CA-15.
Suction strainer	Stainless steel, AISI Type 316.
Lantern ring	Bronze; see paragraph C below.
Pump bowls and suction manifold	Cast iron, ASTM A48, Class 30 or ductile iron, ASTM A536.
Bowl bearings	Bronze; see paragraph C below.
All parts made of fabricated steel including discharge head or motor stand	Carbon steel, ASTM A283, Grade B or C; ASTM A36; or ASTM A53, Grade B.
Column pipe	Carbon steel, ASTM A283, Grade B or C or ASTM A53, Grade A or B.
Line shaft	ASTM A108, Grade 1045 or 1020.
Mounting plate	Carbon steel, ASTM A283, Grade A or B or ASTM A36.
Flanges	ASTM A105, A181, or A182.
Bolts and nuts for discharge head, column pipe flanges, and bowl flanges. See paragraph D below.	Bolts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M. Nuts shall be Type 316 stainless steel conforming to ASTM A194, Grade 8M.
Stuffing box gland parts	Bronze; see paragraph C below.
Gland bolts and nuts	Stainless steel, Type 316.

Any bronze components in contact with water	See paragraph C below.

2. Do not construct the impeller wear ring and bowl liner of the same material. Impeller and bowl liner materials shall have a minimum Brinell hardness difference of 50, unless both the stationary and the rotating wear surfaces have Brinell hardness numbers of at least 400.

3. Bronze components in contact with water shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	0.02% maximum, lead-free
Copper + Nickel + Silicon	83% minimum

O. Strainers

Provide suction strainers on the inlet to each pump as stated in the subsection on "Service Conditions."

P. Soleplate and Anchor Bolts

1. The Contractor shall assign the design and construction of the pump (including bowls, column, and discharge head), motor and supporting stand, and baseplate and soleplate system to the pump manufacturer. The pump manufacturer shall design and construct an integrated system to comply with the specified restraint, deflection, vibration, and critical speed criteria.

2. Provide a steel soleplate to be permanently grouted in place. The thickness and bolting to the discharge head base shall be sufficient to restrain the discharge head against shut off head or any other pump operating condition and provide sufficient rigidity such that the pump and baseplate system meets the specified lateral vibration and critical speed criteria. For fabricated steel discharge heads, the sole plate thickness shall be greater than the top column flange thickness plus the bolt head length. Machine the soleplate topside to mate with a fully machined base of the discharge head.

3. Provide vertical leveling screws spaced for stability on the outside perimeter of the soleplate. Locate the leveling screws adjacent to anchor bolts to minimize distortion during the process of installation. These screws shall be numerous enough to carry the weight of the baseplate, pump, and drive train components without excessive deflection, but in no case shall fewer than six screws be provided. Sandblast the grout contact surfaces of the soleplate in accordance with SSPC SP-6, and coat those surfaces with a primer compatible with epoxy grout.

4. Provide anchor bolts of sufficient quantity and size to restrain any pump operating condition. The anchor bolts shall conform to ASTM A193, Grade 8M with nuts conforming to ASTM A194, Grade 8M.

Q. Spare Parts

1. Provide the following spare parts for each model of pump:

Quantity	Description
One	Impeller wear ring
One	Bowl wear ring
One	Lantern ring (for pumps specified to have packing)
Two sets	Bowl bearings
Two of each size or type	Shaft bearings and spiders for open lineshaft pumps
One	Shaft coupling
Two sets	Packing

2. Pack spare parts in wooden boxes; label with manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 - EXECUTION

A. Service Conditions

1. Pump hydraulic performance characteristics shall be as shown below.

Location	Turlock Well 8
Service	Indoors environmental temperature range of 32°F to 110°F
Elevation	100 feet above mean sea level
Relative humidity	10% to 80%
Fluid temperature range	60°F tp 70°F

Pump Data

Capacity (gpm)	Bowl Total Head (feet)	Minimum Bowl Efficiency (%)
400	290	70
700	340	80
800*	350	80
*Design point.		

Liquid pumped	Water
Maximum pump speed	1,800 rpm
Minimum submergence available	70 feet
Motor horsepower (minimum)	100
Motor type (per Section 262650)	1EHNRTV
Variable speed drive required per Section 262923	Yes
Minimum shaft diameter	1.5 inches
Pump lubrication	Open lineshaft
Minimum discharge connection size	10 inches

Minimum column size	10 inches
Minimum column wall thickness	0.375 inch
Discharge flange rating	Class 150
Pump setting (base of discharge head to inlet of first pump stage)	300 feet
Bearing lubrication	Water
Suction strainer	Yes

B. Welding Procedure and Welder Qualification for Pump Construction

Welding shall comply with the ASME Boiler and Pressure Vessel Code, Section IX. Provide full penetration welds. Open seam butt welds are not permitted. Fabrication, assembly, and erection of pump columns and fabricated discharge heads shall conform to Section 402001.

C. Factory Performance Tests

1. Each pumping unit shall be subjected to a nonwitnessed laboratory performance test. Conduct tests in accordance with ANSI/HI 14.6, using the actual job or a shop driver. The performance test shall be equivalent to ANSI/HI 14.6.

2. No motor overload above nameplate rating will be allowed at any flow up to 120% of the flow at the BEP.

3. Perform an NPSHR test on one pump of each size or model specified.

4. Deviations and fluctuations of test readings shall conform to ASME PTC 8.2, 1.11 (Type A), or ANSI/HI 14.6, paragraph 14.6.3.4.

5. Measure flow by the "Capacity Measurement by Weight," the "Capacity Measurement by Volume," or the "Capacity Measurement by Venturi Meter, Nozzle, or Thin Plate Orifice" methods in ASME PTC 8.2 or ANSI/HI 14.6.

6. For pumps in variable speed service, conduct a test at each operating speed necessary to attain the design points described in the subsection on "Service Conditions."

7. Perform tests and record data, including head, flow rate, speed, and power, at a minimum of five points. These points shall be shutoff, minimum continuous stable flow, midway between minimum stable flow and design flow, design flow, 120% of design flow, and maximum flow.

8. Take vibration readings at rated flow at each test speed.

9. Performance tests shall be "full-scale." The complete pump, including column and discharge elbow, shall be used. Shorten the column to suit the sump depth. Measuring devices shall have been calibrated within the previous year.

10. The pressure tap for head measurement shall be located not less than 10 pipe diameters downstream from the discharge elbow of the test pump.

11. Should results of the full-scale tests indicate, in the opinion of the Owner's Representative, that the pumps will fail to meet any of the specified requirements, the Owner's Representative will notify the Contractor of such failure. The Contractor shall thereupon

require the manufacturer, at no expense to the Owner, to make such modifications and perform additional tests as may be necessary to comply with these specifications.

12. Perform a hydrostatic test on pump pressure-containing parts per ANSI/HI 14.6.

D. Painting and Coating

1. Line and coat interiors and exteriors of pump columns, shaft enclosing tube, discharge elbows, bowl assemblies, and suction bells with fusion-bonded epoxy. Apply coating at factory.

2. Coat interior and exterior of pump columns per Section 099000, System No. 7. Apply coating at factory.

3. Coat interior of discharge elbows per Section 099000, System No. 7. Apply coating at factory.

4. Coat exteriors of bowl assemblies and interiors and exteriors of suction manifold per Section 099000, System No. 7. Apply coating in factory.

5. Coat exterior of discharge head and motor the same as the adjacent piping.

E. Shipment and Storage

1. Prepare equipment for shipment including blocking of the rotor when necessary. Identify blocked rotors by means of corrosion-resistant tags attached with stainless steel wire. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

2. Identify the equipment with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

3. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

4. Store and protect pumps per API 686 (first edition), Chapter 3, paragraphs 1.4 through 1.9, 1.15, 1.17, 1.20, and 1.21 and as described below.

5. Coat exterior machined surfaces with a rust preventative.

6. The interior of the equipment shall be clean and free from scale, welding spatter, and foreign objects.

7. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at place of pump manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

8. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install plugs at place of pump manufacture prior to shipping.

9. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

10. Wrap exposed shafts and shaft couplings with waterproof, moldable waxed cloth or volatile-corrosion-inhibitor paper. Seal the seams with oil-proof adhesive tape.

11. If electric motors are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the motor electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Inspect electrical contacts before start-up.

F. Pump Installation

1. Prior to installing the pump(s) in the well(s), review the well vertical alignment data provided by the Owner and advise the Owner if the pump(s) cannot be installed without binding or placing the column and shaft in flexure.

2. Check to ensure that pump baseplates or soleplates have been provided with vertical leveling screws, as opposed to shims or wedges. Do not use shims and wedges.

3. Provide the manufacturer's recommended lubricants and operating fluids and verify that each piece of equipment contains the amount recommended by the manufacturer.

4. Provide threaded caps for protection of nuts and bolt threads per Section 400500 on the bolts and nuts of the column pipe flanges and bowl flanges.

5. Verify that the installed pump is fully self-supporting before bolting pipe flanges, so that no strain is imparted on the flanges, pipes, or pipe supports from the pump assembly. Adjust the position of the pump assembly so that the pump flanges are plumb and aligned with the adjacent pipe flanges. Do not use temporary shims or jacking nuts for leveling, aligning, or supporting equipment. Provide final grouting of the pump assembly base according to Section 030500.

6. When the alignment is correct, tighten the foundation bolts evenly but not too firmly. Then grout the unit to the foundation. The leveling pieces may be grouted in place. Do not tighten foundation bolts until the grout is hardened a minimum of 48 hours after pouring.

7. Provide continuous protection of the installed equipment from the elements, dust, debris, paint spatter, or other conditions that will adversely affect the unit's operation until such time as the equipment is scheduled for start-up testing.

G. Mounting and Alignment of Vertical Hollow Shaft Drivers

1. Remove the clutch or coupling from the top of the hollow shaft, and mount the driver on top of the discharge head/driver stand. For pump designs requiring the pump head shaft to be installed prior to mounting the driver, lower the hollow shaft driver with care over the head shaft to be sure the latter is not damaged. Check the driver for correct rotation, as given in the manufacturer's installation instructions. Install the head shaft, if not already done, and check it for centering in the hollow shaft. If off-center, check for runout in head shaft, misalignment from discharge head to driver, or out of plumbness of the suspended pump. Shims can be placed under the discharge head to center the head shaft, but shims shall not be placed between the motor and the discharge head unless recommended by the manufacturer.

2. Install the driver coupling or clutch, and check the nonreverse ratchet for operability, if furnished. Install the coupling gib key and the adjusting nut, and raise the shaft assembly with the impeller(s) to the correct running position in accordance with the manufacturer's instructions. Secure the adjusting nut to the clutch, and double-check the driver hold-down bolts for tightness.

H. Field Measurement of Coating Thickness on Columns

Field measure coating thickness on pump columns per Section 402001.

I. Field Testing

1. Bump motor to ensure that motor has been connected for proper rotation prior to coupling pump.

2. Perform field tests for 24 consecutive hours on each installed pump to demonstrate that it performs according to the factory test data.

3. If the measured flows are more than 5% below the flows obtained on the laboratory or factory test, adjust the impellers or provide new impellers or otherwise repair or replace the pumps or calibrate meters or pressure gauges.

4. Conduct vibration level tests with pumps operating at their rated capacity. Adjust or replace pumps that exceed the maximum vibration levels.

5. Operate each pump one at a time. Manually adjust the speed for each pump (one at a time) via the respective VFD unit such that the pump output is 50%, 60%, 80%, and 100% of the maximum capacity specified. The duration at each flow rate shall be at least one hour.

6. Assure that in the automatic mode each pump responds to its pressure signal. Assure that each pump operates at a steady rate (±5% of set point) at any given pressure for 50%, 60%, 80%, and 100% of the maximum capacity specified.

7. Assure that each solenoid valve on the seal water supply line opens and closes when its respective pump starts and stops. Start and stop each pump twice and verify that the pump/solenoid interlock functions.

8. Test the pump system to determine its overall efficiency. This test shall consist of measuring flow, discharge pressure, pumping level, and electrical input kilowatts to the motor at a minimum of five points evenly spaced on the pump curve and determining the ratio of power input to the water to the electrical input power to the motor ("wire-to-water efficiency"). Submit results of this test to the Owner.

9. Demonstrate that the pumping units, drivers, and control system meet the following requirements:

   a. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.

   b. Automatic and manual controls function in accordance with the specified requirements.

   c. Drive equipment operates without being overloaded.

END OF SECTION

SECTION 432160 ELECTRONIC-ACTUATED DIAPHRAGM METERING PUMPS

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of electronic-actuated diaphragm metering pumps.

B. Related Work Specified Elsewhere

1. Equipment, Piping, Duct, and Valve Identification: 400775.

2. Rubber and Plastic Hose and Tubing: 402035.

C. Submittals

1. Submit shop drawings in accordance with Section 5.22 of the Special Provisions.

2. Submit dimensional drawings.

3. Submit manufacturer's catalog data and detail drawings showing metering pump parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show stroke speed at the specified flow. Show linings and coatings.

D. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One labor day to check the installation and advise during start-up, testing, and adjustment of the equipment.

2. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

PART 2 - MATERIALS

A. Manufacturers

The electronic-actuated diaphragm metering pump shall be as manufactured by ProMinent, Grundfos or equal. A single pump manufacturer and model shall be used to meet the service conditions for all locations.

B. Pump Design and Construction

1. The diaphragm-metering pump shall be an electronic pulsing or solenoid driven, positive displacement, disc or tubular diaphragm pump. Pump materials of construction are designated in the subsection on "Service Conditions."

2. Provide the pump with a dial knob for manual stroke length adjustment. The stroke adjustment system shall allow 0% to 100% of full stroke length while the pump is operating.

3. Provide the pump with a separate dial knob for stroke frequency adjustment (10% to 100% of the maximum strokes per minute).

4. The metering pump drive shall be totally enclosed with no exposed moving parts. The solid-state electronic pulser shall be fully encapsulated with no exposed printed circuit etch and be supplied with quick connect terminals at least 3/16 inch (4.75 mm) wide. Electronics shall be housed in a chemical-resistant enclosure at the rear of the pump for maximum protection against chemical spillage.

5. Pressure-relief bypass shall automatically release chemical to pump suction when discharge pressure exceeds the value specified in the subsection on “Service Conditions.” Alternatively, provide a design in which the pump ceases its stroking action when the backpressure exceeds the strength of the magnetic force developed by the power coil.

6. The pump housing shall be of chemical-resistant glass-fiber reinforced thermoplastic.

7. Metering pump valves shall be vented ball type, with balls seating on combination valve seat and seal ring. Valve seat and seal rings shall be renewable by replacing only the combination seat-seal ring.

C. Power Supply

Power supply shall be 120 volts, single phase, 60 hertz.

D. Suction and Discharge Connections

The suction and discharge connections shall accept polyethylene tubing via compression connections.

E. External Interface Signals

1. Accept a remote start/stop signal to the metering pump in the remote mode.

2. Provide a remote status indication of “pump running” with an isolated contact closure, rated for 5 amperes at 120-volt a-c.

3. Provide a remote status indication of local/remote switch position with an isolated contact closure, rated for 5 amperes at 120-volt a-c.

4. Provide a percent of speed with 4- to 20-mA d-c output corresponding to 0% to 100% speed for remote indication of metering pump.

1. Provide a 4- to 20-mA input signal for stroke speed control.

F. Liquids Pumped

Liquids pumped are described below. See the subsection on “Service Conditions” to determine which pumps handle the particular liquid described.

1. Liquid: 12.5% sodium hypochlorite solution

Specific gravity	1.2
Viscosity	1 centipoise
Temperature	45°F to 120°F

G. Spare Parts

1. Provide the following spare parts for each pump:

Quantity	Item
1	Diaphragm
2	Ball check valve assemblies
1	Seat and seal ring assembly

2. Pack spare parts in a wooden box; label with the job location, pump type and model, manufacturer's name and local representative's name, address, and telephone number and attach list of materials contained within.

PART 3 - EXECUTION

A. Equipment Installation

Provide the manufacturer's recommended lubricants for each piece of equipment.

B. Service Conditions

1. Pump hydraulic performance conditions and design data shall be as shown below.

Location	**Well 8 Pump House**
Liquid pumped	Sodium Hypochlorite
Capacity range	0.3 to 1.6 gph
Maximum design discharge pressure	120 psig
Pressure-relief valve setting	75 psig
Maximum required suction lift	5 feet
Remote run/stop signal required?	Yes
Remote status indication of pump running required?	Yes
Remote status indication of local/remote operation required?	Yes
4- to 20-mA output signal for remote indication of pump speed required?	Yes
4- to 20-mA input signal for remote control of pump speed required?	Yes
Toggle switch for selecting internal manual stroke frequency/external remote signal?	Yes
Pump ball check valve construction	Ceramic
Seat and seal ring construction	PTFE
Pump head construction	PVDF
Fittings and connections at pump head	PVDF
Diaphragm construction	PTFE

Manufacturer and model	Grundfos Model DDA, ProMinent Model Beta b or equal

Pump manufacturer to certify that the materials of construction are compatible with the liquid being pumped.

C. Field Testing

Operate each pump, using potable water, for twenty four (24) consecutive hours during which time no repairs shall be required. Assure that manual stroke length and frequency adjustments on the pumps perform over the specified adjustment range. Assure that diaphragms do not leak or tear. Repair or replace any leaking diaphragms. Assure that backpressure and pressure-relief valves have been provided and set as specified. Repair or replace any valves not set or operating as specified.

END OF SECTION