NOTICE TO CONTRACTORS,

PROPOSAL,

AGREEMENT, &

SPECIAL PROVISIONS

FOR CONSTRUCTION ON
Project No: 20-009
Arsenic Mitigation Project Well 38 ICF Treatment

IN STANISLAUS COUNTY,
TURLOCK, CALIFORNIA.

Development Services Department/ Engineering Division

Phone: (209) 668-5417
Contact Person: Stephen Fremming

Nathan Bray, PE
Interim Development Services Director/City Engineer

Proposals shall be delivered to Turlock, California
at or before 2:00 PM on Tuesday, June 30, 2020
at the office of the City Engineer,
Development Services: Engineering Division
156 S. Broadway, Suite 150
Turlock, CA 95380

TABLE OF CONTENTS

END OF TABLE OF CONTENTS

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 Tuesday, June 30th, 2020, for:

City Project No. 20-009
Well 38 Arsenic Mitigation
and ICF Treatment

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.

A **mandatory** pre-bid meeting will be held on-site at 2919 W. Christoffersen Parkway on June 18, 2020 at 10:00 AM. General contractors submitting proposals are required to attend and sign in at the meeting in order for the proposal to be considered responsive.

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 **One Hundred Fifty** dollars **($150)** 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: 5/20/20

CITY OF TURLOCK

By: _____

Nathan Bray, PE
Interim Development Services Director / City Engineer

PROPOSAL

Project No. 20-009

Well 38 Arsenic Mitigation
and ICF Treatment

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.

PROPOSAL SUBMITTAL CHECKLIST

FAILURE TO PROVIDE ALL THE REQUIRED DOCUMENTS LISTED IN THE TABLE BELOW MAY CAUSE THE PROPOSAL TO BE CONSIDERED NON-RESPONSIVE.

Complete Proposal **Page No.**

BIDDING FORM

PROJECT TITLE: Arsenic Mitigation Project Well 38 ICF Treatment
PROJECT NUMBER: 20-009
OPENING DATE: June 30, 2020
OPENING TIME: 2:00 PM

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total
1	Mobilization, Bonds, and Insurance* **Not to exceed $250,000*	LS	1		
2	Traffic Control	LS	1		
3	Implement Environmental Mitigation Measures	LS	1		
4	Prepare and Implement Storm Water Pollution Prevention Plan	LS	1		
5	Prepare and Implement Dust Control Plan	LS	1		
6	Sheeting, Shoring, and Bracing for Worker Protection	LS	1		
7	Pump, Motor and Drive Replacement	LS	1		
8	Demolition and Clearing	LS	1		
9	Site Grading	LS	1		
10	Wrought Iron Fence and Frontage Improvements	LS	1		
11	Yard Piping	LS	1		
12	ICF Filtration System	LS	1		
13	Equalization Tank	LS	1		
14	Painting and Coating	LS	1		
15	Chemical Enclosure	LS	1		
16	Chemical Storage Tanks	LS	1		
17	Chemical Metering Pumps	LS	1		
18	Install Chemical Systems	LS	1		
19	Site Surfacing	LS	1		
20	Signing and Striping	LS	1		
21	Electrical, Instrumentation, and Controls	LS	1		
22	Standby Generator	LS	1		
23	CPM Construction Schedule	LS	1		
24	Startup and Testing	LS	1		
25	Operation and Maintenance Manuals	LS	1		
26	Record Drawings	LS	1		
27	Maintenance Shed	LS	1		
28	All other items of work not included in other bid items	LS	1		
Base Bid Subtotal					

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 _____

TOTAL BASE BID WRITTEN IN FIGURES: $ __, ___ ___ ___ , ___ ___ ___ . ___ ___

TOTAL BASE BID WRITTEN IN WORDS: _____

CONTRACTOR: _____

ADDITIVE BID ALTERNATE NO. 1 - SLURRY SEAL EXISTING ACCESS ROAD

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total
A1	Seal and Coat Existing Access Road	LS	1		

ADDITIVE BID ALTERNATE NO. 1 WRITTEN IN FIGURES: $ ___ ___ ___ , ___ ___ ___ . ___ ___

ADDITIVE BID ALTERNATE NO. 1 WRITTEN IN WORDS: _____

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.

X_____
(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 non collusion and questionnaire to general contractors, a statement of proposed sub contractors, if any, the address of mill, shop or office of any sub contractor, and a statement of work to be performed by sub contractors.

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 co partners 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:_____

X_____
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.

X_____

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 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. 20-009, "Well 38 Arsenic Mitigation and ICF Treatment."**

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

SUB-CONTRACTORS
City Project No. 20-009

Well 38 Arsenic Mitigation
and ICF Treatment

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

Project No. 20-009

Well 38 Arsenic Mitigation and ICF Treatment

THIS PUBLIC IMPROVEMENT AGREEMENT (the "Agreement") is entered into by and between the CITY OF TURLOCK, a California municipal corporation ("City"), and _____, a _____ ("Contractor"), on this ____ day of _____ 20__ (the "Effective Date"). City and Contractor may be collectively referred to herein as the "Parties" or individually as "Party." There are no other parties to this Agreement.

RECITALS

A. City seeks a duly qualified and licensed firm experienced in the construction of Project No. 20-009, "Well 38 Arsenic Mitigation and ICF Treatment" (the "Project").

B. The Project involves the expenditure of funds in excess of $5,000 and constitutes a "public project" pursuant to Public Contract Code section 20161.

C. Contractor has made a proposal to City to provide construction services, a copy of which is attached and incorporated hereto as **Exhibit A** (the "Services").

D. City has determined it is necessary and desirable to employ the services of Contractor to perform construction work on the Project.

E. City has taken appropriate proceedings to authorize construction of the Project and execution of this contract pursuant to Public Contract Code section 20160 et seq.; specifically, on _____, 20___, at a duly noticed meeting of the City Council of the City of Turlock, this contract for the construction of the improvements hereinafter described was awarded to Contractor as the lowest responsive and responsible bidder for said improvements.

NOW, THEREFORE, in consideration of the promises and covenants set forth below, the Parties agree as follows:

AGREEMENT

1. Contract Documents: This Agreement, together with the following documents, are collectively referred to herein as the "Contract Documents":

i. Notice to Bidders;
ii. Contractor's Bid or Proposal accepted by City;
iii. General Conditions, Supplementary Conditions, and Special Provisions of the City of Turlock for Project No. 20-009, "Well 38 Arsenic Mitigation and ICF Treatment;"
iv. Plans and detailed drawings prepared for this Project and approved by City ("Project Plans");
v. All bonds and insurance required by the Contract Documents;
vi. 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; and
vii. The current edition of the City of Turlock Standard Specifications and Drawings.

All of the Contract 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.

2. Term. The Contract shall be effective as of the Effective Date first stated above. Contractor shall not commence work on the Project until it has been given notice by City ("Notice to Proceed"). The Contract shall terminate one (1) year after City accepts Contractor's performance of the Services (the "Term"), unless the Parties mutually agree in writing to terminate the Contract earlier or extend the Term in an agreed writing executed by both Parties.

3. Scope of Work.

(a) *Services.* Contractor shall perform the Services described in Exhibit A, subject to all terms and conditions in the Contract. Contractor shall not receive additional compensation for the performance of any Services not described therein.

(b) *Modification.* City, at any time, by written order, may make changes within the general scope of the work under this Agreement or issue additional instructions, require additional work or direct deletion of work. Contractor shall not proceed with any change involving an increase or decrease in the Contract Price, as defined in Section 4 of this Agreement, or the Completion Schedule without prior written authorization from City. Contractor shall not be entitled to compensation for the performance of any such unauthorized work. Contractor further waives any and all right or remedy by way of restitution or quantum meruit for any and all extra or changed work performed without express and prior written authorization of City. Notwithstanding the foregoing, Contractor shall promptly commence and diligently complete any change to the work subject to City's written authorization issued

pursuant to this Section ; Contractor shall not be relieved or excused from its prompt commencement of diligent completion of any change subject to City's written authorization by virtue of the absence or inability of Contractor and City to agree upon the extent of any adjustment to the Completion Schedule or Contract Price on account of such change. The issuance of a Change Order pursuant to this Section 3 in connection with any change authorized by City shall not be deemed a condition precedent to Contractor's obligation to promptly commence and diligently complete any such change authorized by City hereunder. City's right to make changes shall not invalidate the Contract nor relieve Contractor of any liability or other obligations under the Contract. Any requirement of notice of changes in the scope of work to Contractor's surety shall be the responsibility of Contractor.

(c) *Specific Materials & 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 Project No. 20-009, "Well 38 Arsenic Mitigation and ICF Treatment." The equipment, apparatus, facilities, labor, and material shall be furnished, and said work performed and completed as required by the Contract under the direction and supervision, and subject to the approval, of the City Engineer of or City Engineer's designated agent.

(d) *Exhibits.* All "Exhibits" referred to below or attached hereto are, by this reference, incorporated into the Contract.

	Exhibit Designation	Exhibit Title
1.	Exhibit A	Scope of Services
2.	Exhibit B	Payment by Force Account
3.	Exhibit C	Workers' Compensation Insurance Certification
4.	Exhibit D	Performance Bond
5.	Exhibit E	Payment Bond

4. Contract Price.

City shall pay, and Contractor shall accept in full payment for the work set forth above in Section 3, Scope of Work, an amount not to exceed _____ Dollars ($_____.00) (the "Contract Price"). Said amount shall be paid pursuant to Section 8 of this Agreement. 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 sole discretion of City as follows:

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, as applicable; or

If the work performed is not included on the engineer's estimate associated with a unit price, the change order will be by a mutually agreed lump sum; or

If the change order is not determined as described above in either subdivision (a) or (b), the change order will be determined on the basis of force account in accordance with the provisions set forth in Exhibit B, "Payment by Force Account," attached hereto and incorporated herein by reference.

5. Time for Performance.

The time fixed for the commencement of work under the Contract is within ten (10) working days after the Notice to Proceed has been issued. The project shall be substantially complete before the expiration of **one hundred seventy three** (**173**) working days (the "Substantial Completion Date") beginning on the first day of work or no later than the tenth day after the Notice to Proceed has been issued. Substantial Completion is defined herein as the time at which the work has progressed to the point where, in the opinion of Engineer, the work is sufficiently complete such that the improvements may be utilized for the purposes for which it is intended, including successful completion of all required testing periods. All contract work, including punch list items not necessary for substantial completion, shall be complete before the expiration of **one hundred ninety five** (**195**) working days (the "Final Completion Date") beginning on the first day of work or no later than the tenth day after the Notice to Proceed has been issued. The Substantial Completion Date and the Final Completion Date are collectively referred to herein as the "Completion Dates."

(a) Right of City to Increase Working Days: If Contractor fails to complete the Services by the Completion Dates, 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 City, and if the City Engineer desires to increase said number of working days, the City Engineer shall have the further right to charge 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. No extension of time for completion of Services under the Contract shall be considered unless requested by Contractor at least twenty (20) calendar days prior to the Completion Dates, in writing, to the City Engineer.

The Completion Dates 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 Completion Dates will be determined as follows:

i. Additional working days will be awarded where the amount of time is mutually agreed upon by Contractor and the City Engineer; or

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

1. 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 fifteen (15) days from the beginning of that delay; or

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

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

Contractor shall not be entitled to an adjustment in the Completion Dates for delays within the control of Contractor. Delays resulting from and within the control of a subcontractor or supplier of Contractor shall be deemed to be delays within the control of Contractor.

(b) *Excusable Delays*. Contractor shall not be in breach of the Contract in the event that performance of Services is temporarily interrupted or discontinued due to a "Force Majeure" event which is defined as: riots, wars, sabotage, civil disturbances, insurrections, or explosions; natural disasters, such as floods, earthquakes, landslides, and fires; strikes, lockouts, and other labor disturbances; or other catastrophic events, which are beyond the reasonable control of Contractor. Force Majeure does not include Contractor's financial inability to perform, Contractor's failure to obtain any necessary permits or licenses from other governmental agencies, or Contractor's failure to obtain the right to use the facilities of any public utility where such failure is due solely to the acts or omissions of Contractor. If Contractor's performance of the Services is delayed by an excusable delay, the Completion Dates shall be extended for such reasonable time as determined by the City Engineer. Extensions in time must be requested by Contractor within fifteen (15) calendar days of the excusable delay in order to receive consideration.

(c) *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 Contractor, unable to perform the Services, or the work is thereby suspended or delayed, any of the following steps may be taken:

i. City may, pursuant to resolution of the City Council, grant Contractor additional time for the performance of the Contract, 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 the City Engineer in writing thereof, and give specific reasons therefore; the 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 subdivision (b) of this Section.

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

ii. 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 Contractor shall take all steps possible to minimize this obligation; or

iii. The City Council, by resolution, may suspend the Contract until the cause of inability to perform is removed for a period of not to exceed sixty (60) days.

If the Contract is not canceled, and the inability of Contractor to perform continues without fault on Contractor's part, beyond the time during which the Contract may have been suspended, as herein above provided, the City Council may further suspend the Contract, or either Party hereto may, without incurring any liability, elect to declare the Contract 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 Contract Price for such portion of the Contract as may have been performed; or

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

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

(d) Delay Damages. In the event Contractor, for any reason, fails to perform the Services to the satisfaction of the City Engineer by the Completion Dates, City may, in accordance with Section 7203 of the Public Contract Code, in lieu of any other of its rights authorized by Section 6 of this agreement, deduct from payments or credits due Contractor after such breach a sum equal to Thirty One Hundred Dollars ($3,100.00) for each calendar day beyond the contract time allotted for Substantial Completion, and a sum equal to Eight Hundred Dollars ($800.00) for each calendar day beyond the contract time allotted for Final Completion. This deduction shall not be considered a penalty but shall be considered as delay damages. The aforementioned rates of deduction is an amount agreed to by the Parties as reasonably representing additional construction engineering costs incurred by City if Contractor fails to complete the Services by the Completion Date. However, any deduction assessed as delay damages shall not relieve 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 Services by the Completion Dates. Due account shall be taken of any time extensions granted to Contractor by City. Permitting Contractor to continue work beyond the Completion Dates shall not operate as a waiver on the part of City of any of its rights

under the Contract nor shall it relieve 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 Services by the Completion Dates.

6. Termination.

(a) *Option of City to Terminate Contract for Failure to Complete Services*. If a Party should fail to perform any of its obligations hereunder within the time and in the manner herein provided, or otherwise violates any of the terms of the Contract (the "Defaulting Party"), the other Party shall give notice to the Defaulting Party and allow the Defaulting Party ten (10) days to correct such deficiency. If the Defaulting Party does not correct such deficiency, the other Party may immediately terminate the Contract by giving written notice of such termination, stating the reason for such termination. In such event, Contractor shall be entitled to receive payment for all Services satisfactorily rendered until such termination, provided, however, there shall be deducted from such amount the amount of damage, if any, sustained by virtue of any breach of the Contract by Contractor, including Delay Damages. If payment under the Contract is based upon a lump sum in total or by individual task, payment for Services satisfactorily rendered shall be an amount which bears the same ratio to the total fees specified in this Agreement as the Services satisfactorily rendered hereunder by Contractor to the total services otherwise required to be performed for such total fee, provided, however, that there shall be deducted from such amount the amount of damage, if any sustained by City by virtue of any breach of the Contract by Contractor. Upon termination, Contractor shall deliver copies of all Work Product, as defined in Section 19 of this Agreement, to City. If District terminates the Contract before Contractor commences any Services hereunder, City shall not be obligated to make any payment to Contractor.

(b) If Contractor should be adjudged bankrupt or if it should make a general assignment for the benefit of its creditors, or if a receiver should be appointed on account of its insolvency, or if it or any of its subcontractors should violate any of the provisions of the Contract, City may serve written notice upon it and its surety of its intention to terminate the Contract. Such notice shall contain the reasons for City's intention to terminate the Contract, and unless such violations shall cease within five (5) calendar days after serving of such notice, the Contract shall cease and terminate upon the expiration of said five (5) calendar days. In the event of any such termination, City shall immediately serve written notice thereof upon the surety and Contractor, and the surety shall have the right to take over and perform the Contract; provided however, that, if the surety does not give City written notice of its intention to take over and perform the Contract or does not commence performance thereof within thirty (30) calendar days from the date of the service of such notice, City may take over the work and prosecute the same to completion by contract or any other method it may deem advisable, for the account and at the expense of Contractor, and Contractor and its surety shall be jointly liable to City for any excess cost 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, and other property belonging to Contractor as may be on the Project site and necessary thereof.

7. Liability for Breach:

Neither Party waives the right to recover direct damages against the other for breach of the Contract, including any amount necessary to compensate City for all detriment proximately caused by Contractor's failure to perform its obligations hereunder or which in the ordinary

course of things would be likely to result therefrom. City reserves the right to offset such damages against any payments owed to Contractor. City shall not, in any manner, be liable for special or consequential damages, including but not limited to Contractor's actual or projected lost profits had Contractor completed the Services required by the Contract. In the event of termination by either Party, copies of all finished or unfinished Work Product, as defined in Section 19 of this Agreement, shall become the property of City. Notwithstanding the foregoing, in no event shall City be liable, regardless of whether any claim is based on contract or tort, for any special, consequential, indirect or incidental damages, including, but not limited to, lost profits or revenue, arising out of or in connection with the Contract or the Services performed in connection with the Contract.

8. **Compensation:** City shall make Payments to Contractor in accordance with the provisions of Section 9 of the General Conditions in legally executed and regularly issued warrants of City, drawn on the appropriate fund or funds as required by law and order of the City Council thereof. Contractor shall be administered a progress payment approximately every thirty (30) calendar days from the time work begins according to the payment schedule furnished by the City Engineer at the time work begins. Contractor shall provide access at all reasonable times to all reports, contract records, contract documents, contract files, and personnel necessary to audit and verify Contractor's charges to City under this Contract.

   Monthly progress payments in the amount of 95 percent (95%) of the value of the work will be made to Contractor based on the Contractor's estimate and the schedule of prices contained in the accepted bid. The remaining 5 percent (5%) will be retained by City as partial security for the fulfillment of the Contract except that at any time after 50 percent (50%) of the work has been completed, if the City Engineer finds that satisfactory progress is being made and the Project's critical path of work are on schedule, City may discontinue any further retention. Such discontinuance will only be made upon the written request of Contractor. City may, at any time the City Engineer finds that satisfactory progress is not being made, again institute retention of 5 percent (5%) as specified above. Payment will be made as soon as possible after the preparation of the Contractor's estimate. City shall pay the remaining 5 percent (5%) of the value of the Services completed under this Contract, if unencumbered by retentions for claims, not sooner than the expiration of thirty-five (35) calendar days from the date of acceptance of the work completed by Contractor by the City Council and not later than sixty (60) days from the "completion" of the Services as said term is defined in Public Contract Code section 7107(c).

   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 thirty (30) working days or less. Payment of any progress payment, or the acceptance thereof by Contractor, shall not constitute acceptance of the work performed under this Contractor, or any portion thereof, and shall in no way reduce the liability of Contractor to replace unsatisfactory work or materials, though the unsatisfactory character of such work or materials may not have been apparent or detected at the time such payment was made.

   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 section 8128 et seq. from each subcontractor and materials supplier. The form of said waivers and releases shall be as set forth in Civil Code section 3262(d)(2).

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

9. **Disputes Pertaining to Payment for Work:** Should any dispute arise respecting the true value of any work performed, 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 the Contract, such dispute shall be decided by the City Engineer, and the decision of the latter shall be final and conclusive. The Parties agree to comply with the claims resolution procedures set forth in Public Contract Code section 9204 when applicable.

(a) *Claims Processing.* Any submission of a claim by Contractor must comply with the requirements of Public Contract Code section 9204. Upon receipt of a claim pursuant to this section, City shall conduct a reasonable review of the claim and, within a period not to exceed forty-five (45) days, shall provide Contractor a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, the Parties may, by mutual agreement, extend the time period provided in this subdivision. 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 sixty (60) days after City issues its written statement. If Contractor disputes City's written response, or if City fails to respond to a claim issued pursuant to this section within the time prescribed, Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute.

(b) *Meet-and-Confer Conference.* Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, City shall schedule a meet-and-confer conference within thirty (30) days for settlement of the dispute. Within ten (10) business days following the conclusion of the meet-and-confer conference, if the claim or any portion of the claim remains in dispute, 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 sixty (60) days after the City issues its written statement.

(c) *Nonbinding Mediation.* Any disputed portion of the claim, as identified by Contractor in writing, shall be submitted to nonbinding mediation, with th Parties sharing the associated costs equally. The Parties shall mutually agree to a mediator within ten (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 judicial review pursuant to Section 23 of this Agreement.

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

10. Permits and Care of Work: 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 Section 1 of the Special Provisions. Contractor has examined the Project site 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 the Contract. 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.

11. Public Works and Payment of Prevailing Wage:

(a) *Monitoring and Enforcement.* In accordance with the provisions of Sections 1725.5, 1771.1, 1771.3, and 1771.4 of the Labor Code, all work performed under the Contract is subject to compliance monitoring and enforcement by the Department of Industrial Relations ("DIR"). All work performed by Contractor or its subcontractors under the Contract is subject to the requirements of Labor Code section 1720 et seq. 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 of the Labor Code at the time the contract is awarded. Contractor and its subcontractors shall furnish the records specified in Section 1776 of the Labor Code directly to the Labor Commissioner, at least monthly, in the format prescribed by the Labor Commissioner.

In accordance with the provisions of Section 1773.3 of the Labor Code, City shall provide notice to DIR of the award of this Contract within thirty (30) working days of the award. The notice shall be transmitted electronically in a format specified by DIR and shall include the name of Contractor, any subcontractor listed on the successful bid, the bid and contract award dates, the contract amount, the estimated start and completion dates, Project location, and any additional information DIR specifies that aids in the administration and enforcement of Section 1720 et seq. of the Labor Code.

(b) *Wages & Hours of Employment*: In the performance of the Services under the 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 DIR for the community. Contractor shall forfeit as penalty Twenty-five and no/100ths Dollars ($25.00) to be paid to City for each workman employed in the execution of the Contract by Contractor or its subcontractor(s), for each calendar day during which any workman is required or permitted to labor more than eight (8) hours, in violation of provisions of Labor Code section 1810 et seq. Contractor shall post prevailing wage rates at the Project no later than the first day Contractor commences performance of the Services under the Contract.

12. **Superintendence by Contractor:** Contractor shall give personal superintendence to the work on the Project 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 Contractor.

13. **Inspection and Testing by City:** Contractor shall at all times maintain proper facilities and provide safe access for inspection by City to all parts of the work performed on the Project and to the shops wherein the work is in preparation. Contractor shall notify City with sufficient time in advance of the manufacture of production materials to be supplied by Contractor under the 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 Project. Contractor shall also furnish to City, in triplicate, certified copies of all factory and mill test reports upon request.

14. **Conformity with Law and Safety:** Contractor shall observe and comply with all applicable laws, ordinances, codes, and regulations of governmental agencies, including federal, state, municipal, and local governing bodies having jurisdiction over any or all of the scope of Services, including all provisions of the Occupational Safety and Health Act of 1979 as amended, all California Occupational Safety and Health Regulations, the California Building Code, the American with Disabilities Act, any copyright, patent, or trademark law, and all other applicable federal, state, municipal, and local safety regulations, appropriate trade association safety standards, and appropriate equipment manufacturer instructions. All Services performed by Contractor or its subcontractors must be in accordance with these laws, ordinances, codes, and regulations. Contractor's failure to comply with any laws, ordinances, codes, or regulations applicable to the performance of the Services hereunder shall constitute a breach of contract. In cases where standards conflict, the standard providing the highest degree of protection shall prevail.

    If a death, serious personal injury or substantial property damage occurs in connection with the performance of the Contract, Contractor shall immediately notify City's risk manager by telephone. If any accident occurs in connection with the Contract, Contractor shall promptly submit a written report to City, in such form as City may require. This report shall include the following information: (a) name and address of the injured or deceased person(s); (b) name and address of Contractor's subcontractor, if any; (c) name and address of Contractor's liability insurance carrier; and (d) a detailed description of the accident, including whether any of City's equipment, tools, or materials were involved.

    If a release of a hazardous material, substance, or waste occurs in connection with the performance of the Contract, Contractor shall immediately notify City. Contractor shall not store hazardous materials or hazardous waste within City limits without a proper permit from City.

15. **Other Contracts:** City may award other contracts for additional work on the Project, 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.

16. Bonds: Concurrently with the execution hereof, Contractor shall furnish, on the forms provided herein as Exhibits D and E, respectively, corporate surety bonds to the benefit of City, issued by a surety company acceptable to City and authorized and admitted to do business in the state of California, as follows:

(a) *Faithful Performance Bond.* In an amount equal to at least one hundred percent (100%) of the Contract Price as security for the faithful performance of the Contract. The bond shall contain a provision that the surety thereon waives the provisions of Sections 2819 and 2845 of the Civil Code.

(b) *Payment 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 the Contract. The bond shall be in accordance with the provisions of Sections 3225, 3226, and 3247 through 3252, inclusive, of the Civil Code and Section 13020 of the Unemployment Insurance Code of California. Said bond shall also contain a provision that the surety thereon waives the provisions of Sections 2819 and 2845 of the Civil Code.

The surety companies shall familiarize themselves with all provisions and conditions of the Contract. It is understood and agreed that the surety or sureties waive the right of special notification of any modification or alterations, omissions or reductions, extra or additional work, extensions of time, or any other act or acts by City or its authorized agents under the terms of this Contract and failure to so notify the surety or sureties of such changes shall in no way relieve the surety or sureties of their obligations under the Contract.

17. Indemnification:

(c) *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 ("City's Agents") from and against any and all losses, liabilities, damages, costs, and expenses, including legal counsel's fees and costs but only to the extent Contractor or its subcontractors are responsible for such damages, liabilities and costs on a comparative basis of fault between Contractor or its subcontractors and City in the performance of professional services under the Contract. Contractor shall not be obligated to defend or indemnify City for City's own negligence or for the negligence of others.

(d) *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 City's Agents 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 the Contract 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.

18. Contractor's Insurance: Concurrently with the execution hereof, Contractor shall furnish City with satisfactory proof of carriage of the insurance required under this section, and that Contractor shall give City at least sixty (60) days prior notice of the cancellation of any policy during the Term of this contract. 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 the Contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the Services 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 the Contract. Any available insurance proceeds in excess of the specified minimum limits and coverage shall be available to City.

(e) *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 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. The 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 the 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 the Contract, 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.*

(f) *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.

(g) 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.

(h) *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. The policy shall be provided for replacement value on an "all-risk" basis. City shall be named as Loss Payee on the policy and there shall be no coinsurance penalty provision in any such policy. The 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.

(i) *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 the Contract 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.

(j) *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 the Contract, 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 the Contract.

(k) 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 and City's Agents; or (2) Contractor shall provide a financial guarantee satisfactory to City guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

(l) 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 City has provided prior approval.

(m) 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 Section 18. 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.

(n) 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 affect this waiver of subrogation.

(o) 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.

19. Ownership of Work Product: Any and all work, artwork, copy, posters, billboards, photographs, videotapes, audiotapes, systems designs, software, reports, designs, specifications, drawings, diagrams, surveys, source codes, professional or technical information or data, photographs, notes, letters, emails, or any original works of authorship created by contractor or its subcontractors or subcontractors in connection with Services performed under the Contract ("Work Product") shall be works for hire as defined under Title 17 of the United States Code, and all copyrights in such works are the property of City. In the event that it is ever determined that any Work Product created by Contractor or its subcontractors or subcontractors under the Contract are not works for hire under U.S. law, Contractor hereby assigns all copyrights to such Work Product to City. With the prior written approval of the City Engineer, Contractor may retain and use copies of such Work Product for reference and as documentation of its experience and capabilities.

All Work Product shall become the property of City irrespective of where located or stored and Contractor agrees to deliver all such documents and information to City, without charge and in whatever form it exists, upon the Completion Date, as may be extended. Contractor shall have no ownership interest in such Work Product.

All Work Product of Contractor under the Contract, including written information which City will cause to be distributed for either internal or public circulation, including both preliminary and final drafts, shall be delivered to City in both printed and electronic form, or as may be specific in Exhibit A.

When the Contract is terminated, Contractor agrees to return to City all documents, drawings, photographs, and other written or graphic material, however produced, that it received from City or City's Agents, in connection with the performance of its Services under the Contract. All materials shall be returned in the same condition as received.

20. Taxes: Payment of any taxes, including California sales and use taxes, levied upon the Contract, the transaction, or the Services or goods delivered pursuant hereto, shall be the obligation of Contractor. Contractor shall cooperate with City to the full extent possible to maximize the local allocation of California sales and use tax to 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 purchases of $500,000 or more to allocate the use tax to City.

21. Independent Contractor: At all times during the Term of the Contract, Contractor shall be deemed to be an independent contractor and shall be wholly responsible for the manner in which Contractor performs the Services required under the Contract. Contractor shall be liable for its acts and omissions, and those of its employees, contractors, subcontractors, representatives, volunteers, and its agents. Nothing contained herein shall be construed as creating an employment, agency, or partnership relationship between City and Contractor. City shall have the right to control Contractor only insofar as the result of Contractor's Services rendered pursuant to the Contract; however, City shall not have the right to control the means by which Contractor accomplishes Services rendered pursuant to the Contract.

22. Contractor Not Agent: Except as City may specify in writing, Contractor shall have no authority, express or implied, to act on behalf of City in any capacity whatsoever as an agent. Contractor shall have no authority, express or implied, pursuant to the Contract to bind City to any obligation whatsoever.

23. Arbitration of Disputes: All claims, disputes, and other matters in question between City and Contractor arising out of, or relating to, this Contract or the breach thereof, including claims of Contractor for extra compensation of Services related to the project, shall be decided by arbitration before a single arbitrator in accordance with the provisions of Sections 1281 through 1284.2 of the Code of Civil Procedure (the "Arbitration Laws") unless the Parties mutually agree otherwise. The provisions of Section 1283.05 of the Arbitration Laws apply to any arbitration proceeding except as otherwise provided in the Contract. The arbitrator shall have authority to decide all issues between the Parties including, but not limited to, claims for extras, delay, and liquidated damages, if any, provided for the Contract, matters involving defects in the Services performed by Contractor or its subcontractors, rights to payment, and whether the

necessary procedures for arbitration have been followed. The award rendered by the arbitrator shall be final and judgment may be entered upon it in accordance with applicable law in any court having competent jurisdiction thereof.

Notice of the demand for arbitration shall be filed in writing with the other Party. The demand for arbitration shall be made within a reasonable time after the claim, dispute, or other matter in question has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such claim, dispute, or other matter in question would be barred by the applicable statute of limitations.

The parties shall jointly appoint an arbitrator within fifteen (15) calendar days of the date of giving the notice of the demand for arbitration. If the Parties are unable to jointly agree upon the appointment of an arbitrator within said fifteen (15) calendar day period, and do not agree in writing to extend said period for a fixed period, then either Party may seek to have the arbitrator appointed by the Superior Court of Stanislaus County in accordance with the Arbitration Laws.

If any proceeding is brought to contest the right to arbitrate and it is determined that such right exists, the losing Party shall pay all costs and attorney's fees incurred by the prevailing Party.

In addition to the other rules of law which may be applicable to any arbitration hereunder, the following shall apply:

(a) Promptly upon the filing of the arbitration, each Party shall be required to set forth in writing and to serve upon each other Party a detailed statement of its contentions of fact and law.

(b) All Parties to the arbitration shall be entitled to the discovery procedures provided under Section 1283.05 of the California Code of Civil Procedure.

(c) The arbitration shall be commenced and conducted as expeditiously as possible consistent with affording reasonable discovery as provided herein.

(d) These additional rules shall be implemented and applied by the arbitrator.

The costs of arbitration shall be borne by the Parties as determined by the arbitrator, but each Party shall bear its own attorney's fees associated with the dispute with the other Party and to the arbitration.

24. Provisions Cumulative: The provisions of the Contract are cumulative, and in addition to and not in limitation of, any other rights or remedies available to City.

25. Notices: All notices shall be in writing and delivered in person or transmitted by certified mail, postage prepaid. Any Party hereto may at any time, by giving ten (10) days' written notice to the other Party hereto, designate any other address in substitution of the address to which such notice or communication shall be given. Such notices or communications shall be given to the Parties at their addresses set forth below.

If to City:	**City of Turlock** **Attn: City Engineer** **156 S. Broadway, Suite 150** **Turlock, CA 95380-5461**
With courtesy copies to:	**Churchwell White LLP** **Attn: Douglas L. White, City Attorney** **1414 K Street, 3rd Floor** **Sacramento, CA 95814**
If to Contractor:	_____ _____ _____
If to Contractor's Sureties:	_____ _____ _____ _____

26. City Contract Administrator: The City's contract administrator and contact person for this Agreement is:

Stephen Fremming
City of Turlock Engineering Division
156 S. Broadway, Suite 150
Turlock, California 95380-5461
Telephone: (209) 668-5417
E-mail: sfremming@turlock.ca.us

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

28. Antitrust Claims: Contractor or its subcontractors offer and agree to assign to 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.

29. Use of City Project Number: Contractor or its subcontractors agree 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 Contractor or its subcontractors from using their own project numbers for their own internal use.

30. No Conflict of Interest: Contractor represents that no conflict of interest will be created under state or federal law by entering into or in carrying out the Contract.

31. **Confidentiality:** Contractor understands and agrees that, in the performance of Services under the Contract, or in the contemplation thereof, Contractor may have access to private or confidential information that may be owned or controlled by City and that such information may contain proprietary or confidential details, the disclosure of which to third parties may be damaging to City ("Confidential Information"). Contractor shall not, either during or after the Term, disclose to any third party any Confidential Information without the prior written consent of City. If City gives Contractor written authorization to make any such disclosure, Contractor shall do so only within the limits and to the extent of that authorization. Contractor may be directed or advised by the City Attorney on various matters relating to the performance of Services on the Project or on other matters pertaining to the Project, and in such event, Contractor agrees that it will treat all communications between itself, its employees, and its subcontracts as being communications which are within the attorney-client privilege.

32. **Modification.** No alteration, amendment, modification, or termination of the Contract shall be valid unless made in writing and executed by all Parties to the Contract.

33. **Waiver:** No covenant, term, or condition or the breach thereof shall be deemed waived, except by written consent of the Party against whom the waiver is claimed, and any waiver of the breach of any covenant, term, or condition shall not be deemed to be a waiver of any preceding or succeeding breach of the same or any other covenant, term, or condition.

34. **Assignment:** No Party to the Contract shall assign, transfer, or otherwise dispose of this Agreement in whole or in party to any individual, firm, or corporation without the prior written consent of the other Party. Subject to the foregoing provisions, the Contract shall be binding upon, and inure to the benefit of, the respective successors and assigns of the Parties hereto.

35. **Authority:** All Parties to this Agreement warrant and represent that they have the power and authority to enter into this Agreement and the names, titles, and capacities herein stated on behalf of any entities, persons, states, or firms represented or purported to be represented by such entities, person, states, or firms and that all former requirements necessary or required by state or federal law in order to enter into the Contract have been fully complied with. Further, by entering into this Agreement, neither Party hereto shall have breached the terms or conditions of any other contract or agreement to which such Party is obligated, which such breach would have a material effect hereon.

36. **Governing Law:** The Contract shall be governed and construed in accordance with the laws of the state of California.

37. **Severability:** If the Contract in its entirety is determined by an arbitrator or a court of competent jurisdiction to be invalid or unenforceable, the Contract shall automatically terminate as of the date of final entry of judgment. If any provision of the Contract shall be determined to be invalid and unenforceable, or if any provision of the Contract is rendered invalid or unenforceable according the terms of any federal or state statute, which becomes effective after the Effective Date of this Agreement, the remaining provisions shall continue in full force and effect and shall be construed to give effect to the intent of this Agreement.

38. **Counterparts:** This Agreement may be executed simultaneously and in several counterparts, each of which shall be deemed an original but together shall constitute one and the same instrument.

39. **Mandatory and Permissive:** "Shall" and "will" and "agrees" are mandatory. "May" and "can" are permissive.

40. **Headings:** Headings used in this Agreement are for reference purposes only and shall not be considered in construing this Agreement.

41. **Attorney's Fees and Costs:** Except as expressly provided for in Section 23 of this Agreement, if any action at law or in equity, including action for declaratory relief, is brought to enforce or interpret the provisions of the Contract, the prevailing Party shall be entitled to reasonable attorney's fees and costs, which may be set by the court in the same action or in a separate action brought for that purpose, in addition to any other relief to which such Party may be entitled.

42. **Necessary Acts and Further Assurances:** The Parties shall, at their own cost and expense, execute and deliver such further documents and instruments and shall take such other actions as may be reasonably required or appropriate to evidence or carry out the intent and purposes of the Contract.

[*Signatures on Following Page*]

IN WITNESS WHEREOF, three identical counterparts of this agreement, consisting of a total of 20 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: _____
Toby Wells, P.E., City Manager

Date: _____

APPROVED AS TO SUFFICIENCY:

By: _____
Nathan Bray, Interim Development Services Director/City Engineer

APPROVED AS TO FORM:

By: _____
Douglas L. White, City Attorney

ATTEST:

By: _____
Jennifer Land, City Clerk

EXHIBIT A
SCOPE OF SERVICES

Insert Contractor's Proposal here.

EXHIBIT B
PAYMENT BY FORCE ACCOUNT

For work paid by force account, the City Engineer compares City's records to Contractor's daily force account work report. When the City Engineer and Contractor agree on the contents of the daily force account work reports, the City Engineer accepts the report and City pays for the work. If the records differ, City pays for the work based only on the information shown on City's records. If a subcontractor performs work at force account, work paid at force account will be accepted at an additional 2 percent (2%) markup to the total cost of that work, including markups, 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, City excludes Contractor's cost of determining the adjustment. Payment for owner-operated labor and equipment is made at the market-priced invoice submitted.

A. Labor. Labor payment is full compensation for the cost of labor used in the direct performance of the work plus a 5 percent (5%) markup, as set forth below, and consistent with California Labor Code section 1770 et seq. 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 (5%) 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:

(a) Home office overhead
(b) Field office overhead
(c) Bond costs
(d) Profit

(e) Labor liability insurance
(f) Other fixed or administrative costs that are not costs of labor used in the direct performance of the work

B. Materials. Material payment is full compensation for materials the Contractor furnishes and uses in the work. The City 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 City Engineer believes the material purchase prices are excessive, City pays the lowest current wholesale price for a similar material quantity;

4. If Contractor procured the materials from a source 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; and
   4.2 Current wholesale price for those materials;

5 If Contractor does not submit a material cost record within thirty (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

C. 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 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 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, Contractor must obtain authorization for the equipment rental's original location.

The City 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 City uses the rental document rates or minimum rental cost terms if:
        1.3.1. Rented from equipment business 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 City Engineer for equipment not listed in *Labor Surcharge and Equipment Rental Rates*. Contractor may submit cost information that helps the City Engineer establish the rental rate but City uses the rental document rates or minimum rental cost terms if:
    2.1. Rented from equipment business Contractor does not own.
    2.2. The City 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

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

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

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

D. 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

E. 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 four (4) hours or less is paid as 1/2 day
3. Operated four (4) hours or more is paid as one (1) day

If the minimum total time exceeds eight (8) hours and if hourly rates are listed, City rounds up hours operated to the nearest 1/2-hour increment and pays based on the hours shown in 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

F. 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

G. Non-Owner-Operated Dump Truck Rental. Contractor shall submit the rental rate for non-owner-operated dump truck rental to City. The City Engineer shall determine 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, an additional markup of 2 percent (2%) will be added to the total cost of that extra work including all markups specified in this Section. The additional 2 percent (2%) markup shall reimburse Contractor for additional administrative costs, and no other additional payment will be made by reason of performance of the extra work by a subcontractor.

EXHIBIT C
WORKERS' COMPENSATION INSURANCE CERTIFICATION

Pursuant to Section 18(b) of the Agreement, 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: ( ) _____

EXHIBIT D
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. 20-009, "Well 38 Arsenic Mitigation and ICF Treatment;"** 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 of Turlock reserves the right to refuse use of any Contractor assigned by any surety to complete the work.

[*Signatures on Following Page*]

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their seals this _____ day of _____, 20__, 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

EXHIBIT E
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. 20-009, "Well 38 Arsenic Mitigation and ICF Treatment"**; 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.

[*Signatures on Following Page*]

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their seals this _____ day of _____, 20__, 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

SPECIAL PROVISIONS

City Project No: 20-009

Well 38 Arsenic Mitigation
and ICF Treatment

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. A mandatory pre-bid meeting will be held on-site at 2919 W. Christoffersen Parkway on June 18, 2020 at 10:00 AM.

3. Contractor shall coordinate electrical connection with Turlock Irrigation District.

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 Bidding 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. 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:

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.

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.

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.

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 Bidding 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.

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 Bidding 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.

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.

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.

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

Bid protests are due in writing by the fifth 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

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 Contract.

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.

The Contractor may request to work outside of regular working hours as defined in Section 5.11 "Working Hours," of these Special Provisions. Such requests shall be reviewed by the City. If the request is approved, Contractor shall reimburse the City of Turlock the actual premium cost of engineering, inspection, testing, and/or other overhead expenses which would not otherwise be paid for during normal working hours. Should such work be undertaken at the request of the City, this reimbursement will not be required.

Attention is directed to Section 5 of the Contract for "Delay Damages" in effect for this contract.

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. 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:

The contractor shall promptly, and before the following conditions are disturbed, notify the local public entity, in writing, of any:

1. Material that the contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.
2. Subsurface or latent physical conditions at the site differing from those indicated by information about the site made available to bidders prior to the deadline for submitting bids.
3. Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

Upon notification of any of the above, the City shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the contractor's cost of, or the time required for, performance of any part of the work, a change order shall be issued to modify the contract scope.

In the event that a dispute arises between the City and Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the contractor's cost of, or time required for, performance of any part of the work, the contractor shall not be excused from any scheduled completion date provided for by the contract, but shall proceed with all work to be performed under the contract. The contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between the contracting parties.

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 19, "Payments to Contractor," of the Contract.

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.

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.

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:

Order or work shall be in accordance with the provisions in Section 5-1.05, "Order of Work," of the Caltrans Standard Specifications and these special provisions.

5.19 AS-BUILTS:

Provide and maintain on the jobsite one complete set of prints of all drawings which form a part of the contract. Immediately after each portion of the work is installed, indicate all deviations from the original design shown in the drawings either by additional sketches or ink thereon. Upon completion of the job, deliver this record set to the Owner's Representative. The Contractor shall identify all utilities that are located in the field. Submittal of as-built drawings approved by the Engineer as meeting the above requirements is a condition to completion of the work.

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:

General submittals shall be made in accordance with Section 5.25, "Internet Based Construction Management System," of these special provisions.
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 fifteen (15) 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.

Submittals shall include the following:

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

- 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.
- 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.
- 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.
- 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.

5.23 NOTICE OF POTENTIAL CLAIM:

Attention is directed to Section 5-1.43 "Potential Claims and Dispute Resolution," of the Caltrans Standard Specifications.

5.24 PRESERVATION OF EXISTING MONUMENTS:

Contractor shall preserve existing survey monuments to the maximum extent possible. Contractor shall notify Engineer of all monuments that may or will be disturbed by construction operations. Engineer will arrange for a surveyor to tie off said monuments. Once Contractor is finished with its construction operations, the City's hired surveying firm 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.

5.25 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 "Notice of Potential Claim" of the special provisions.

5.26 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.

The work includes all necessary labor, materials, tools, equipment and any incidentals needed to perform the improvements as shown on the contract plans.

5.27 PERMITS:

A. The Contractor shall prepare and submit Permit Registration Documents required under the Construction Activities Storm Water General Permit as described in Section 01 57 23 of the technical specifications. Under this permit, the Contractor is required to prepare the Storm Water Pollution Prevention Plan and pay appurtenant fees

B. Obtain and pay the fees for the following permits:

Name or Type of Permit	**Name, Address, Telephone Number of Permitting Agency**
Encroachment Permit (This is a no-fee permit)	City of Turlock Engineering Division 156 S. Broadway, Suite 150 Turlock, CA 95380 (209) 668-5520 Fax (209) 668-5563
Dust Control Plan	San Joaquin Valley Air Pollution Control District Northern Region Office 4800 Enterprise Way Modesto, CA 95356 (209) 557-6400
State Water Resources Control Board (SWRCB) – Construction Activities Storm Water General Permit (2009-0009-DWQ) (SWPPP)	State Water Resources Control Board Sacramento, CA (916) 341-5536

Contact the permitting agencies listed above for current fees associated with each permit.

5.28 TRAFFIC MANAGEMENT PLAN:

The Contractor shall develop and submit a temporary traffic control plan (TTCP) to the Engineer for review. The TTCP shall be prepared and signed by a person competent to perform said design. If the Engineer accepts the TTCP, the Contractor shall implement the TTCP.

The Contractor will be allowed to close lanes of traffic to accomplish the Work, provided that one lane in each direction is open to traffic. If the Work requires closure of lanes that would make it impossible to leave one lane in each direction open to traffic, the Contractor will be allowed to use flaggers and have one lane of traffic open. The Contractor will bear the entire cost of the flagging.

The Contractor will not be allowed to close the road to traffic at any point.

Contractor shall meet the requirements outlined in Section 11 of the City of Turlock Standard Specifications.

The Contractor shall bear the full cost of flagging operations.

The Contractor shall only be allowed to place traffic control devices for closures of lanes in areas where Work is occurring. If an area is not being worked on, the traffic control devices must not restrict traffic.

In times of low visibility (dark, foggy, etc.) the Contractor shall affix flashing beacons to all traffic control devices in a standard method.

If any component in the traffic control system is displaced, or ceases to operate or function as specified, from any cause, during the progress of the work, Contractor shall immediately repair said component to its original condition or replace said component and shall restore the component to its original location.

The cost of repairing or replacing said traffic control devices shall be the responsibility of Contractor. The cost of supplying any and all traffic control devices shall be considered as included in other contract items of work and no additional compensation will be allowed therefore.

If the Contractor does not adhere to the accepted TTCP, the Engineer will shut down the Contractor for the remaining day and any subsequent days it take the Contractor to make traffic control devices adhere to the accepted TTCP. Such shut downs are not subject to additional working days.

5.29 ADDITIVE BID ALTERNATE NO. 1 – SEAL AND COAT EXISTING ACCESS ROAD

At City's option, Additive Bid Alternate No. 1 may be added to the scope of work.

Slurry seal shall conform to the provisions in Section 37-3, "Slurry Seal," of the Caltrans Standard Specifications and these special provisions.

Asphaltic emulsion shall be, at the option of the Contractor, Type PMQS1h or PMCQS1h and shall conform to the requirements in Section 94, "Asphaltic Emulsions," of the Caltrans Standard Specifications.

The contractor shall prepare the existing paved surfaces for slurry seal. Such preparation shall include thoroughly cleaning the area by sweeping, or other means necessary to remove all loose particles of paving, oil spots, vegetation, dirt, debris, litter, leaves and any other extraneous material.

All manhole covers, valve boxes, monuments, and utility vaults shall be masked prior to slurry sealing, in accordance with Section 37-2.03D "Surface Preparation" of the Caltrans Specifications. Masking shall be performed in such a manner that lettering is not obliterated and covers are not sealed in place. Contractor shall utilize smaller/less heavy equipment on bike path areas to prevent damage of existing surfaces. Any damage to the existing surface of bike paths resulting from the Contractors operations shall be repaired by the Contractor at no expense to the City. At the conclusion of slurry sealing, the Contractor shall remove all masking material and demonstrate the "freeness" of all covers to the satisfaction of the City Engineer.

Hand tools shall be available in order to remove spillage. Ridges or bumps in the finished surface will not be permitted. The mixture shall be uniform and homogeneous after spreading on the surface and shall not show separation of the emulsion and aggregate after setting.

Vehicular traffic, including public traffic, shall not be allowed upon the work until, in the Engineer's judgment; the slurry sealed surface is able to sustain traffic without visible damage or marking. A minimum of 4 hours cure time will be required for all treated surfaces.

ROLLING AFTER SLURRY

Once the slurry seal surface has cured sufficiently to support rubber tired vehicle traffic and the danger of material pick-up has passed, the slurry shall be rolled by a pneumatic-tired roller having tire pressures of 40-50 pounds per square inch. Sufficient water shall be used to prevent pick-up of the slurry material. Excess wetting water on the roller tires will not be permitted.

The pneumatic-tired roller shall have a minimum weight of 18,000 pounds (with ballast) and a minimum of 7 smooth treaded tires, each with a minimum tire size of 7.5x15 and 6 ply rating. A smaller pneumatic-tired roller may be required on bike path areas to prevent damage to existing surfaces. Any damage to the existing surface of bike paths resulting from the Contractors operations shall be repaired by the Contractor at no expense to the City. A minimum of 4 complete passes over each slurry street shall be performed to achieve a tight and dense surface.

The price paid for Type II Slurry Seals shall include all labor, materials, tools, equipment, saw cutting, excavation, hauling, rolling, sweeping, compaction and all work necessary for the completion of these items as specified in the City of Turlock Standard Specifications and Drawings, the plans, these Special Provisions and as directed by the Engineer.

CITY OF TURLOCK
CITY PROJECT NO. 20-009

TECHNICAL

SPECIFICATIONS

FOR THE

WELL 38 ARSENIC MITIGATION AND ICF TREATMENT

Issued for Bidding Purposes Only

MAY 2020

Date Signed 5/1/2020

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

SECTION 01 11 10

COORDINATION OF WORK

PART 1 GENERAL

1.1 RESPONSIBILITY OF CONTRACTOR

A. If any part of the Work depends for proper execution or results upon the work of others, the Contractor shall inspect and promptly report to the Engineer any apparent discrepancies or defects in such work of others that render it unsuitable for such proper execution and results. Failure of the Contractor to so inspect and report shall constitute an acceptance of the work of others as fit and proper except as to defects which may develop in the work of others after execution of the Work by the Contractor.

1.2 WORK INVOLVED WITH EXISTING SYSTEM

A. Existing materials and equipment removed not designated to be salvaged for Owner's review in the execution of the Work shall become the property of the Contractor and shall be removed from, and disposed of, off the site by the Contractor in an acceptable and lawful manner.

1.3 COORDINATION OF WORK

A. The Contractor shall maintain overall coordination for the execution of the Work. Based on the Construction Schedule prepared in accordance with these Specifications, he shall obtain from each of his subcontractors a similar schedule and shall be responsible for all parties maintaining these schedules or for coordinating required modifications.

END SECTION

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SECTION 01 20 00

MEASUREMENT & PAYMENT

PART 1 GENERAL

1.1 MEASUREMENT

A. Unless otherwise specified in the Contract Documents, quantities of work shall be determined from measurements or dimensions in a horizontal plane. All measurements shall be made in accordance with United States Standard Measures and shall be measured on the basis of “in-place” quantities.

B. After the work has been completed, the Engineer will make field measurements of unit price items in order to determine the quantities of the various items as a basis for payment. On all unit price items, the contractor will be paid for the actual amount of the work performed in accordance with the contract documents, as computed from field measurements unless bid item is Lump Sum Bid Item.

C. Work or quantities not listed in the description of bid items are considered incidental to other construction and will not be measured. Compensation for such incidental work is considered to be included in the various items of work bid.

1.2 INCREASED OR DECREASED QUANTITIES

A. Increases or decreases in quantities shall be governed by the Contract Documents.

B. All written requests for adjustment shall be made no later than five working days after notification by the Engineer that the item of work is complete.

END SECTION

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SECTION 01 22 00

EXPLANATION OF BID ITEMS

PART 1 GENERAL

The Contract payment for the specified items of work as set forth in the Bid Schedule shall be full compensation for furnishing all labor, materials, methods or processes, implements, tools, equipment and incidentals and for doing all work involved as required by the provisions of the Contract Documents for a complete in place and operational system.

A. Unless otherwise specified in the Specifications, quantities of work shall be determined per each, or from measurements or dimensions in a horizontal plane. All materials shall be measured on the basis of "in place" quantities and paid for using the units listed in the bid schedule.

B. Except as noted, the Engineer will make field measurements of unit price items in order to determine the quantities of the various items as a basis for payment. On all unit price items, the contractor will be paid for the actual amount of the work performed in accordance with the contract documents, as computed from field measurements.

1. Work or quantities not listed in the description of bid items are considered incidental to other construction and will not be separately measured or paid for. Compensation for such work and/or material shall be included in the prices paid for other items of work.

1.2 BID ITEMS

Bid Item 1 – **Mobilization, Bonds and Insurance:** Payment for this item shall include full compensation for all labor, materials, tools, equipment and incidentals making up the cost of mobilization, move-in, move-out, all necessary bonds, insurance, permits, licenses, and fees required during the performance of the work as specified. This item also includes demobilization, including the removal of all equipment, supplies, personnel and incidentals from the project at the end of construction and any other cost due to requirements in the contract. Payment shall not exceed **$250,000**. Payment for mobilization shall be made with the first progress payment and shall not exceed 80 percent of the bid item amount. Payment for demobilization shall be made with the last progress payment and shall not be less than 20 percent of the bid item amount.

Bid Item 2 – **Traffic Control:** Payment under this item shall be considered full compensation for all labor, materials, tools, equipment and incidentals required to maintain traffic control measures for the project limits in accordance with the Plans and specifications. This bid item will be paid for by Lump Sum, prorated, based on percentage of contract work completed.

Bid Item 3 – **Implement Environmental Mitigation Measures:** This bid item is a lump sum bid for all materials, labor and appurtenances required to prepare and

implement Environmental Mitigation Measures in accordance with the Mitigation Monitoring Program and Section 01 57 19 of these Specifications, including completion of pre-construction surveys and all other work associated with complying with State and Federal requirements. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

Bid Item 4 – **Prepare and Implement Storm Water Pollution Prevention Plan:** This bid item is a lump sum bid for all materials, labor and appurtenances required to prepare and implement a Storm Water Pollution Prevention Plan ("SWPPP"), including preparing the SWPPP, uploading required documents on the SMARTS website, testing, monitoring and all other work associated with implementing the SWPPP and complying with State and Federal permit requirements. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

Bid Item 5 – **Prepare and Implement Dust Control Plan:** This bid item includes all labor, equipment, materials, and appurtenances required to prepare and implement a Dust Control Plan (DCP) in accordance with the San Joaquin Valley Air Pollution Control District (SJVAPCD) Regulation VIII and these specifications. The Contractor shall prepare the DCP, including required exhibits and submit them to the Engineer for approval, prior to commencement of any work at the project site. The Contractor shall keep the DCP current as required. The DCP shall include, but not be limited to dust-control training, dust control plans, recordkeeping, and construction notification. Plans must be submitted to the SJVAPCD at least 30 days prior to commencing construction.

The Contractor shall keep a copy of the approved DCP and amendments thereto at the job site and in the general business office of the Contractor. In addition, the Contractor shall make available to the Owner copies of all amendments to the DCP as prepared by the Contractor. The DCP shall be made available upon request of a representative of the SJVAPCD or U.S. Environmental Protection Agency. Requests by the public shall be directed to the Engineer.

Full compensation for all the costs involved in preparing, obtaining approval of, revising and amending and implementation of the DCP shall be included in the lump sum bid of this bid item.

This bid item will be paid for by Lump Sum on a fixed prorated basis.

Bid Item 6 – **Worker Protection:** This bid item is a lump sum bid for providing worker protection from trench failures and other hazards that may occur during construction. The Contractor shall comply with the provisions of the Construction Safety Orders, Tunnel Safety Orders, and General Safety Orders issued by the State of California of Industrial Safety, as well as all other applicable laws, ordinances, and regulations, as they pertain to the protection of workers from the hazard of caving ground. The Contractor shall obtain a permit from the Division of Industrial Safety of the State of California prior to commencement of construction. This bid item shall be paid as a lump sum, prorated based on the percentage of contract work completed.

Bid Item 7 – **Pump, Motor and Drive Replacement:** This bid item is a lump sum bid for furnishing and installing the 450 HP electric motor and new well pump, and shall include full compensation for furnishing all labor, equipment and materials to complete the work as described herein, including disinfection of the well pump per AWWA standards, and no additional compensation will be made therefore. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

Bid Item 8 – **Demolition and Clearing:** This bid item is a lump sum bid for the cost of all work involved in demolition and clearing and grubbing the project site. Contractor shall obtain a demolition permit for the existing maintenance shed. Areas shall be stripped of surface vegetation, including clearing and grubbing of all trees, vines, stumps, roots, concrete, fencing, debris and unsuitable material, within the project site area including fill slopes. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

Bid Item 9 – **Site Grading:** This bid item is a lump sum bid for the cost of all earthwork associated with rough and finish grading, including but not limited to, excavation, importing borrow (if required) and exporting and disposing of excess and unsuitable material, temporarily stockpiling unsuitable material during construction and related work, over excavation and subgrade preparation and compaction, grading drainage swales, placing and compacting engineered fill to the lines and grades shown on the Plan. The Contractor is responsible for preparing his own estimate of earthwork quantities for the purpose of preparing a lump sum bid price.

Bid Item 10 – **Metal Fence and Frontage Improvements:** This bid item is a lump sum item for all work associated with furnishing and installing a metal fence, drive gates with all appurtenances required to enclose the site as specified in the Plans and Specification. This bid item also includes all landscaping and irrigation costs for landscaping improvements shown on the plans.

Bid Item 11 – **Yard Piping:** This bid item includes all below grade piping and appurtenances associated with the water, process treatment, sewer, and storm drain piping systems. Above grade piping and appurtenances shall be included with each individual process bid item. This bid item includes trenching, bedding, shading and compaction, backfill and compaction, pipe, fittings, restrained joints, valves, manholes, cleanouts, catch basins, appurtenances, testing, video inspection, and tie-ins. Completed item shall provide a complete and fully operational onsite yard piping system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 12 – **ICF Filtration System:** This bid item includes installing three (3) vertical pressure filters, filter media, flow meters, flow control valves, associated piping, fittings, pipe supports, valves, concrete foundation and appurtenances for proper function of the treatment system as detailed in the bid documents. Completed item shall provide a complete and fully operational pressure filters, media, piping, & appurtenances system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 13 – **Equalization Tank:** This bid item includes furnishing and installing a bolted steel equalization tank, appurtenances, and foundation complete in place, and shall be full compensation for tank design; furnishing all labor, equipment and materials to complete the installation, including: over excavation, preparation of earthwork and foundation construction, import fill material for sub grade and foundation, tank construction, ladders, hatches, gauges, vents and other tank accessories, painting, testing, and disinfection. Completed item shall provide a complete and fully operational equalization water tank, foundation, & appurtenances system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 14 – **Painting and Coating:** This bid item includes painting and coating all metal tanks and above ground piping (not including the maintenance shed and chemical storage enclosure), including associated preparation, application, testing and cleanup, and shall be full compensation for furnishing all labor, equipment, and materials to complete the installation as indicated in the Plans and Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 15 – **Chemical Enclosure:** This bid item includes furnishing and installing a chemical enclosure, fill station including associated reinforced concrete foundation, curbs, design and install pre-fabricated steel structure, fencing, and all labor, equipment, materials, and incidentals necessary for proper completion of the enclosure and fill station. All wet utilities, dry utilities, chemical feed, and electrical are included in other bid items. Completed item shall provide a complete and fully operational chemical enclosure system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 16 – **Chemical Storage Tanks:** This bid item includes furnishing and installing chemical tanks as indicated in the plans and specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 17 – **Chemical Metering Pumps:** This bid item includes furnishing and installing chemical metering pumps and skids, as indicated in the plans and specifications, testing, and startup. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 18 – **Install Chemical Systems:** This bid item includes chemical tubing and electrical racking system, trenching, bedding, shading and compaction, backfill and compaction, electrical conduit, service tubing, fittings, pipe supports, taps, static mixers, injection quills, meters, valves, appurtenances, tie-in's, wiring, electrical connections, painting, testing, and startup. The chemical feed system is comprised of conduits containing various chemical feed service tubing, and connections at various chemical feed locations. The metering system shall extend from chemical enclosure to various injection points as shown on the plans. Completed item shall provide a complete and fully operational chemical feed system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 19 – **Site Surfacing:** This bid item is a lump sum bid for all work associated with constructing the asphalt concrete surfacing, concrete surfacing and Class II AB surfacing for the site access road, sidewalks, and parking area. Work in this bid

item shall include, but is not limited to, placing and compacting aggregate base and asphalt concrete pavement to the lines and grades shown on the Plans. This bid item shall be paid for by lump sum on a prorated basis.

Bid Item 20 – **Signing and Striping:** Full costs involved in this bid item shall be included in the lump sum bid price bid for Signing and Striping, and no additional payment shall be made.

Bid Item 21 – **Electrical, Instrumentation, and Controls:** This bid item includes furnishing and installing all electrical equipment, lighting, new electrical service, instrumentation and controls with integration as described in the Plans and Specifications. Completed item shall provide a complete and fully operational electrical, telemetry system and integration system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 22 – **Standby Generator:** This bid item is a lump sum bid a standby generator and controls, including but not limited to, furnishing and installing standby generator, concrete foundation slab, bollards, connection to conduits and conductors furnished under other bid items, and all appurtenances, testing, and start up. All conduit and grounding conductors shown going to the generator pad and the transfer switch shall be included in the base bid under the base bid item for "Electrical Instrumentation and Controls."

The Contractor shall submit an application to the San Joaquin Valley Air Pollution Control District, upon approval of the generator submittal by the Engineer, and upon an Authority to Construct (ATC) permit on behalf of the Owner. The Contractor is responsible for paying all fees associated with obtaining said permit.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete standby generator and appurtenances in conformance with the Plans and Specifications, San Joaquin Valley Air Pollution Control District requirements and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

Bid Item 23 – **CPM Construction Schedule:** This bid item includes preparing and maintaining CPM construction schedule for the duration of the project. The CPM construction schedule shall show continuously updated critical path items, activity durations, and anticipated completion dates. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 24 – **Startup and Testing:** This bid item includes furnishing services associated with startup and testing. Refer to the specific requirements for each process in the Technical Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 25 – **Operation and Maintenance Manuals:** This bid item includes preparing and furnishing an operations and maintenance manual for all equipment. Refer to the specific requirements for each process in the Technical Specifications. This

bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 26 – **Record Drawings:** This bid item includes preparing and furnishing a complete set of record drawings. Refer to the General Conditions for specific requirements. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 27 – **Maintenance Shed:** This bid item includes furnishing and installing a prefabricated maintenance shed, including associated reinforced concrete foundation, pre-fabricated steel structure, mechanical/plumbing, architectural ADA compliant restroom, and all labor, equipment, materials, and incidentals necessary for proper completion of the building. All wet utilities, dry utilities, and electrical are included in other bid items. Completed item shall provide a complete and fully prefabricated maintenance shed. Contractor shall provide a schedule of values for billing purposes only with their Engineer approved prefabricated metal building design. The Contractor will be responsible for applying for and obtaining a building permit and paying all permit fees through the City of Turlock. The item will be paid for by Lump Sum on a prorated basis based on the schedule of values.

A1 Alternative Bid Item – Seal and Coat Existing Access Road: This bid item includes preparing and coating the existing access road as shown on the plans per City standards. This bid item will be paid for by Lump Sum on a prorated basis.

END SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work described in this section includes general requirements and procedures related to the preparation and transmission of submittals to include Shop Drawings, Samples, Manuals, and Record Drawings.

1.2 RELATED WORK

A. City of Turlock Bidding and Contract Documents

B. Individual equipment specifications

1.3 GENERAL

A. Before submitting a Shop Drawing or Sample, Contractor shall have:

1. Reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

2. Determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

3. Determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4. Determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

B. Submit each submittal document under separate cover or transmittal. Transmittal shall include the following identification data, as applicable:

1. Contract number

2. Project name and location

3. Submittal number and revision

4. Product identification

5. Applicable contract drawing number, specification section, and paragraph number

6. Stamp Space: Blank space of approximately 2-1/2 inches high by 4 inches wide adjacent to the identification data to receive Engineer's status stamp.

7. Contractor’s certification statement as described below

C. To each submittal affix the following signed Certification Statement.

1. "Certification Statement: By this submittal, we hereby represent that we have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and pertinent data and we have checked and coordinated each item with other applicable approved drawings and all Contract requirements."

D. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

E. Furnish neat, legible, and sufficiently explicit detail to enable proper review for Contract compliance.

F. Contractor assumes all risks of error and omission.

G. Work performed before approval, or not conforming to approved submittals, shall be at Contractor's risk.

H. Submittal requirements contained in this specification are in addition to specific submittal requirements contained in individual equipment specification sections.

1.4 APPROVAL PROCESS

A. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer’s review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

B. Engineer’s review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

C. Engineer’s review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

D. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has given Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the Contract Documents and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

E. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

F. Submittals will be returned, marked with one of the following classifications:

1. NO EXCEPTIONS TAKEN: Accepted subject to its compatibility with further submittals and additional partial submittals for portions of the work not covered in this submittal. Does not constitute approval or deletion of specified or required items not shown in the partial submittal.

2. MAKE CORRECTIONS NOTED: Same as 1.a., except that minor corrections as noted shall be made by the Contractor. No re-submittal required.

3. REVISE AND RESUBMIT: Rejected because of major inconsistencies or errors which shall be resolved or corrected by the Contractor prior to subsequent review by the Engineer. Re-submittal required.

4. SUBMIT SPECIFIED ITEM: Minor item in submittal missing or incomplete. Submit data, specifications, drawings covering specified item only. Submittal shall be referenced to the main submittal under review.

5. REJECTED: Submitted material does not conform to Plans and Specifications in major respect, i.e.: wrong item, wrong size, model, capacity, or material. Re-submittal required.

PART 2 SUBMITTAL DOCUMENTS

2.1 SHOP DRAWINGS

A. Unless otherwise noted in the individual specification sections, submit five (5) sets of shop drawings.

B. All catalog and specification sheets shall be clearly marked to indicate the specific model number and configuration to be used. Items not applicable to the project shall be crossed out.

C. Show complete and detailed fabrication; assembly and installation details; wiring and control diagrams; catalog data; pamphlets; descriptive literature; and performance and test data.

D. Include calculations or other information sufficient to show comprehensive description of structure, equipment, or system provided and its intended manner of use.

E. Include Manufacturer's installation recommendations.

2.2 SAMPLES

A. Unless otherwise noted in the individual specification sections, submit three (3) samples of each item.

B. Samples shall be representative of the actual material proposed for use in the project and of sufficient size to demonstrate design, color, texture, and finish.

C. Permanently attach to each sample

1. The contract number

2. Project name and location

3. Product identification

4. Applicable contract drawing and specification section number

5. Subcontractor's, vendor's and/or manufacturer's name, address, and telephone number.

D. Certain samples may be tested for specific requirements by the Owner and/or Engineer prior to approval. Failure of sample to pass tests will be sufficient cause for refusal to consider further samples of the same brand and make.

E. Rejected samples will be returned upon request, and resubmittals shall consist of new samples.

2.3 RECORD DRAWINGS

A. Maintain 1 record copy of Contract Documents at site in good order and annotated to show revisions made during construction. Keep annotations current for possible inspection.

1. Make record drawings available to Engineer at all times during life of Contract.

2. Drawings: Made part of record drawings and to include:

a. Contract Drawings: Annotate or redraft, as required, to show revisions, substitutions, variations, omissions, and discrepancies made or discovered during construction concerning location and depth of utilities, piping, ductbanks, conduits, manholes, pumps, valves, vaults, and other equipment. Make revisions and show on all drawing views with actual dimensions established to permanent points.

b. Working/Layout Drawings: When required as submittals, record actual layouts of conduit runs between various items of electrical equipment for power, control, and instrumentation; wire sizes, numbers, and functions; configuration of conduits; piping layouts; and duct layouts.

3. Before preliminary inspection, furnish reproducible of record drawings. At completion of Contract and before final payment is made, furnish Engineer 1 set of reproducibles of finally approved record drawings reflecting revisions herein described.

2.4 OPERATION AND MAINTENANCE MANUALS

A. Furnish Operation and Maintenance Manuals for various types of equipment and systems, as required by Contract Documents. Operation and Maintenance Manuals shall be provided for all mechanical and electrical equipment. Unless otherwise indicated, furnish separate manual for each piece of equipment and system. If manual contains other items or equipment, indicate where specified items are located in manual. Include in manual complete information necessary to operate, maintain, and repair specific equipment and system furnished under this Contract, and include the following specific requirements;

1. Contents.

a. Table of Contents and Index.

b. Brief description of equipment/system and principal components.

c. Starting and stopping procedures, both normal and emergency.

d. Installation, maintenance, and overhaul instructions including detailed assembly drawings with parts list and numbers, and recommended spare parts list with recommended quantity, manufacturer's price, supplier's address, and telephone number.

e. Recommended schedule for servicing, including technical data sheets that indicate weights and types of oil, grease, or other lubricants recommended for use and their application procedures.

f. One copy of each component wiring diagram and system wiring diagram showing wire size and identification.

g. One approved copy of each submittal with changes made during construction properly noted, including test certificates, characteristic curves, factory and field test results.

h. For electrical systems, include dimensioned installation drawings, single line diagrams, control diagrams, wiring and connection diagrams, list of material for contactors, relays and controls, outline drawings showing relays, meters, controls and indication equipment mounted on equipment or inside cubicles, control and protective schematics, and recommended relay settings.

2. Material:

   a. Covers: Oil, moisture, and wear resistant 9 inches by 11-1/2 inches size.

   b. Pages: 60 pound paper 8-1/2 inches by 11 inches size with minimum of 2 punched holes 8-1/2 inches apart reinforced with plastic, cloth, or metal.

   c. Fasteners: Metal screw post or Acco metal strap type.

   d. Diagrams and Illustrations: Attach foldouts, as required.

B. Copies:

1. Submit five (5) preliminary copies of manuals for review and approval no later than date of shipment of equipment. Installation shall not begin until manuals are accepted by Engineer. Include in preliminary copies all items required under “Contents” above. Three copies will be marked and returned to Contractor.

2. Deliver seven (7) copies of finally approved manuals to Engineer before startup.

END SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

PART 1 GENERAL

1.1 GENERAL

A. The Contractor shall provide all temporary facilities and utilities required for completion of the Work as well as safety precautions and programs. No attempt is made to set out in detail the Contractor's means or methods necessary to accomplish the tasks involved.

1.2 TEMPORARY UTILITIES

A. Water

1. The Contractor may make arrangements with the Owner to use municipal water where appropriate during construction.

2. Water used for human consumption shall be kept free from contamination and shall conform to the requirements of the State and local authorities for potable water.

B. Sanitary Facilities

1. The Contractor shall provide suitable and adequate sanitary conveniences for the use his staff at the site of the Work. Such conveniences shall include chemical toilets or water closets and shall be located at appropriate locations at the site of the Work. All sanitary conveniences shall conform to the regulations of the public authority having jurisdiction over such matters. At the completion of the Work, all such sanitary conveniences shall be removed and the site left in a sanitary condition.

2. With respect to sanitation facilities, the Contractor shall cooperate with and follow directions of representatives of the Public Health Service. State and City Public Health Service representatives shall have access to the Work, whether it is in preparation or progress, and the Contractor shall provide facilities for such access and inspection.

1.3 TEMPORARY CONSTRUCTION FACILITIES

A. Construction hoists, shoring, and similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.

B. Temporary supports shall be designed with an adequate safety factor to assure adequate load bearing capability. The Contractor shall submit design calculations

prepared by a professional registered engineer for staging and shoring prior to application of loads.

C. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations from one hour before sunset each day to one hour after sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded in such a manner as to prevent person from falling, walking, or otherwise entering any excavation in any street, roadway, parking lot, treatment plant, or any other area, public or private.

D. The Contractor shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers. Such devices shall, as a minimum, conform to the requirements of Cal/OSHA.

E. At such time or times any temporary construction facilities and utilities are no longer required for the work, the Contractor shall notify the Engineer of his intent and schedule for removal of the temporary facilities and utilities, and obtain the Engineer's approval before removing the same. As approved, the Contractor shall remove the temporary facilities and utilities from the site as his property and leave the site in such condition as specified, as directed by the Engineer, and/or as indicated on the Plans.

1.4 ACCESS ROADS AND STAGING AREA

A. Adequately access shall be maintained to all storage areas and other areas to which frequent access is required. The Contractor shall limit the location of his storage of equipment and materials outside of the project site. The Contractor shall make his own arrangements for space that may be required and bear all associated costs. The Contractor shall provide any temporary storage required for the protection of equipment and materials as recommended by manufacturers of such materials.

B. Storage and protection:

1. Materials and equipment shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Exposed metal surfaces of valves, fittings and similar materials shall be coated with accordance with manufacturer’s recommendations to prevent corrosion.

2. Storage shall be arranged to provide access for inspection. The Contractor shall periodically inspect to assure materials and equipment are undamaged and are maintained under required conditions.

END SECTION

SECTION 01 57 19

ENVIRONMENTAL MITIGATION MEASURES

PART 1 GENERAL

1.1 GENERAL

A. The Contractor shall implement the environmental mitigation measures described in the following sections, excepting those measures specifically identified to be completed by the Owner.

1.2 NOISE

A. The Project shall comply with the Turlock General Plan noise guidelines regarding construction.

1.3 CULTURAL RESOURCES

A. Discovery of Archaeological and Human Remains

1. In the event that archaeological resources are encountered at any time during development or ground-moving activities within the entire project area, all work in the vicinity of the find shall halt until a qualified archaeologist can assess the discovery. The City shall implement all recommendations of the archaeologist necessary to avoid or reduce to a less than significant level potential impacts to cultural resource. Appropriate actions could include a Data Recovery Plan or preservation in place.

2. If human remains are uncovered, or in any other case when human remains are discovered during construction, the Stanislaus County Coroner is to be notified to arrange proper treatment and disposition. If the remains are identified—on the basis of archaeological context, age, cultural associations, or biological traits—as those of a Native American, California Health and Safety Code 7050.5 and Public Resource Code 5097.98 require that the coroner notify the NAHC within 24 hours of discovery. The NAHC would then identify the Most Likely Descendent who would determine the manner in which the remains are treated.

1.4 BIOLOGICAL RESOURCES

A. Pre-construction Requirements/ Mitigation Requirements for Specific Species

1. Nesting Birds

a. The Project's construction activities shall occur, if feasible, between September 16 and January 31 (outside of nesting bird season) in an effort to avoid impacts to nesting birds.

b. If activities must occur within nesting bird season (February 1 to September 15), a qualified biologist shall conduct pre-construction surveys for active nests within 30 days prior to the start of construction. The survey shall include the proposed work area and surrounding lands within 0.5 mile. If no active nests are observed, no further mitigation is required. Raptor nests are considered "active" upon the nest-building stage.

c. On discovery of any active nests near work areas, the biologist shall determine appropriate construction setback distances based on applicable CDFW and/or USFWS guidelines and/or the biology of the species in question. Construction buffers shall be identified with flagging, fencing, or other easily visible means, and shall be maintained until the biologist has determined that the nestlings have fledged.

END OF SECTION

SECTION 01 57 23

STORM WATER POLLUTION PREVENTION PLAN

PART 1 GENERAL

1.1 WORK INCLUDES

A. The Contractor shall apply for and obtain coverage under State of California Construction General Permit Order 2009-0009-DWQ as amended per 2010-0014-DWQ and 2012-0006-DWQ (CGP) at least three weeks before starting Work and shall implement storm water pollution prevention measures as prescribed in the Legally Responsible Party approved SWPPP to prevent sediment and/or pollutants from entering storm drains, streams, or water bodies throughout the duration of the Work in compliance with the permit requirements, including CalGreen Building Standards. Work shall be performed in accordance with all Federal, State, and local regulations.

B. The Contractor shall furnish and exercise every reasonable precaution to protect channels, storm drains, and bodies of water from pollution and provide all labor, materials, tools, and equipment necessary to prevent storm water pollution associated with construction activities, including preparation of Stormwater Pollution Prevention Plan (SWPPP) and amendments if necessary for CGP Compliance, installation, maintenance and final removal of all temporary and permanent erosion and sediment control measures, in accordance with the requirements of the Contract Documents.

1. The Legally Responsible Party (LRP) is City of Turlock.

2. The Approved Signatory for the LRP is Fallon Martin.

C. **Penalties**: Failure to comply with this Section may result in significant fines and possible imprisonment. The Regional Water Quality Control Board (RWQCB) or other prosecuting authority may assess fines for each violation. Should the City be fined or penalized as a result of the Contractor failing to comply with this Section and applicable permit requirements, the Contractor shall reimburse the City for any and all fines, penalties and related costs.

D. All costs for work required for compliance with this Section shall be included in the price bid for SWPPP Preparation and Monitoring.

1.2 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures.

B. Submittals under this section shall be completed and submitted at least three weeks prior to beginning work and within 10 days of issuance of the Notice to Proceed.

1. In the event CalGreen regulatory requirements govern, the contractor shall submit a Good Housekeeping plan demonstrating pollution prevention

measures and steps to be taken to ensure no pollutant discharges from the project site.

2. In the event that CGP Waiver conditions govern, the contractor shall submit the Erosivity Value calculation, the corresponding project schedule, total disturbed area calculations, and a Good Housekeeping Plan demonstrating pollution prevention measures and steps to be taken to ensure no pollutant discharges from the project site to be submitted to the State Water Board via the SMARTS system. All documents shall be kept onsite in either a job trailer or accessible lockbox.

3. In the event that a CGP Traditional or LUP SWPPP is required, or CGP Waiver conditions no longer govern, the contractor shall submit the appropriate project type SWPPP, Risk Level/Type Level Determination, additional Permit Registration Documents, Annual Reports, Sampling and Analysis reports, and all other permit compliance documents to be submitted to the State Water Board via the SMARTS system. All documents shall be kept onsite in either a job trailer or accessible lockbox.

C. Certifications

1. As applicable to the appropriate permit requirements:

a. Copy of the Certificate of Training issued by CASQA demonstrating qualification of the designated QSD or CBPELSG Licensed QSD Training Program proof of good standing.

b. Copy of the Certificate of Training issued by CASQA demonstrating qualification of the designated QSP(s) or CBPELSG Licensed QSD Training Program proof of good standing.

D. Submit all required inspection reports (weekly, quarterly, storm event (pre, during and post), quarterly, and sampling results) to QSD & LRP within 24 hours of inspection.

1.3 QUALITY ASSURANCE

At minimum, the following measures shall be taken to help ensure control of storm water and non-storm water pollution. These measures shall not be construed to limit or override the measures set forth and called for in the SWPPP.

A. Control the rate and effect of dewatering in such a manner as to avoid all objectionable settlement and subsidence and to assure the integrity of the finished work.

B. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, establish reference points and observe at frequent intervals to detect any settlement that may develop. Conduct the dewatering operation in a manner that protects adjacent natural resources and facilities. Cost of repairing all damage to adjacent resources and facilities shall be the sole responsibility of the Contractor.

C. Before commencing grading, excavation or filling in any part of the site, Contractor shall construct swales, diversion channels, inlet protection barriers, sedimentation traps, and other measures to guide runoff away from the work area and to capture eroded material before it reaches natural water courses. The measures shall be in accordance with the approved storm water pollution prevention plans.

D. Arrange demolition activities to minimize erosion to the maximum practical extent. Clearing, excavation, and grading shall be limited to those areas of the Project site necessary for demolition. Minimize the area exposed and unprotected.

E. Clearly mark and delineate the work limits activities. Equipment shall not be allowed to operate outside the limits of work or to disturb existing vegetation. Excavation and grading shall be completed during the dry season to the maximum extent possible.

1.4 GENERAL REQUIREMENTS

A. The Contractor shall exercise care in preserving vegetation and protecting property, to avoid disturbing areas beyond the limits of the Work and promptly repair any damage caused by Contractor operations.

B. The Contractor shall provide all necessary water pollution control devices to prevent, control, and abate water pollution, and implement good housekeeping pollution control measures to reduce the discharge of pollutants from the Site to the maximum extent practicable. These water pollution control devices include structural BMPs, drains, gutters, slope protection blankets and retention basins and shall be constructed concurrently with other Work at the earliest practicable time.

C. Stockpiles of earth and other construction-related materials shall be protected from being transported from the Site by wind or water using covers or equivalent.

D. The Contractor shall properly store and handle fuels, oils, solvents, and other toxic materials in a manner not to contaminate the soil or surface waters, enter the groundwater, or be placed where they may enter a live stream, channel, drain, or other water conveyance facilities. All approved toxic storage containers shall be protected from weather. Spills shall be cleaned immediately, and soiled materials shall be properly disposed of. Spills shall not be washed into live streams, channels, drains, storm drains, or other water conveyance facilities.

E. Excess or waste concrete shall not be washed into the public way or any drainage systems. The concrete wastes shall be retained on-site until they can be appropriately disposed of or recycled. Concrete wastes shall not be washed into live streams, channels, drains, storm drains, other water conveyance facilities, bare ground or unapproved concrete washout containment areas.

F. Non-stormwater runoff from equipment washing, vehicle washing, and any other activities shall be contained at the work site and properly disposed of. Non-stormwater runoff shall not be allowed to enter live streams, channels, drains, storm drains, or other water conveyance facilities.

G. The Contractor shall prevent sediments and other materials to be tracked from the Site by vehicle traffic. Construction entrance roadways shall be stabilized to inhibit sediments from being deposited onto public ways. The Contractor shall immediately sweep up accidental depositions and not allow depositions to be washed away by rain or by any other means.

1.5 REGULATORY REQUIREMENTS

A. The Contractor shall comply with the requirements of the State Water Resources Control Board (SWRCB), RWQCB, California Administrative Code, California Building Code, Owner and any other agencies having jurisdiction in storm water and non-storm water discharges and waste management.

B. General Permit Registration Documents:

1. The Contractor shall employ or contract with qualified personnel to prepare all compliance documents in accordance with the applicable regulatory requirements.

2. All engineering calculations, reports, and drawings shall be prepared, and signed by a California licensed engineer in accordance with California Business and Professional Code Section 6700, et seq.

3. The LRPs qualified personnel shall file the required documents, as necessary, through the SWRCB's Storm Water Multiple Application and Report Tracking System (SMARTS) website.

4. The Contractor shall mail the appropriate application fee to the SWRCB no later than two (2) days after notification of submittal to the SWRCB via SMARTS. The Contractor shall affix the SWRCB Fee Statement Letter to the application fee. The Contractor shall pay all amendment and/or annual fees for subsequent years as required by the CGP.

5. The Contractor shall not commence any construction work until a Waste Discharger Identification (WDID) number assigned by the SWRCB is received. The Contractor shall retain a copy of the WDID onsite, as evidence of the SWRCB acceptance of the PRDs/SWPPP/Waiver.

C. The Contractor shall comply with the following prohibitions and limitations:

1. Discharge prohibitions shall be in accordance with Article III of the CGP.

2. Effluent released from the project site shall meet the requirements of Article V of the CGP.

3. Receiving water limitations shall comply with the requirements of Article VI of the CGP.

1.6 STORM WATER POLLUTION PREVENTION PLAN IMPLEMENTATION

A. General Requirements:

1. Implementation of all BMPs shall be overseen by trained personnel employed or retained by the Contractor.

2. All required site monitoring and water testing, as necessary, shall be overseen by a QSP employed or retained by the Contractor.

3. All erosion and sediment control measures shall be implemented as specified in the SWPPP or Good Housekeeping Plan.

4. A copy of the Good Housekeeping Plan/Waiver Documents/SWPPP, including working details (fact sheets) for construction site BMPs and applicable amendments, shall be kept and maintained by the Contractor on the construction site and continuously updated in accordance with CGP requirements to reflect current site conditions throughout the duration of the project.

B. The Contractor shall implement all activities required by the CGP for the Type and/or Risk Level of the project as detailed in the SWPPP in accordance with the CGP. The SWPPP shall Identify applicable best management practices (BMPs). All stormwater or non-stormwater pollution prevention activities specified in the SWPPP shall comply with the guidance provided in the "*Stormwater Best Management Practice Handbook, Construction,*" November 2009 or more current edition, published by the California Stormwater Quality Association (CASQA).

1. The SWPPP shall detail the placement of physical BMPs required for installation and the methods used to comply with those BMPs. The Contractor's preferred techniques shall show how it will comply with the stated objectives of the SWPPP and the terms of the CGP.

C. Non-Stormwater Management: As specified in CGP Attachment C, D or E as appropriate to the project Risk Level, the SWPPP shall discuss any non-stormwater sources (i.e., landscaping, irrigation, pipe flushing, street washing and dewatering). In addition, the SWPPP shall include standard observation measures and BMPs, including BCT/BAT practices that are to be implemented in order to reduce the pollutant loading in the discharge waters.

D. Amendments: All SWPPP amendments shall be prepared by the Contractor's QSD at no additional cost to the Owner.

1. The Contractor shall, at no additional cost to the Owner, amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of pollutants to stormwater. All fees as determined by the SWRCB will be paid by the Contractor.

2. The Contractor shall, at no additional cost to the Owner, amend the SWPPP if it is in violation of any conditions of the CGP or has not achieved the general objective of reducing pollutants in stormwater discharges. All fees as determined by the SWRCB will be paid by the Contractor.

E. Annual Reporting: The Contractor shall submit to the LRP an annual report and all required information for SMARTS data entry, no later than August 15th of each year. The LRP shall submit to the SWRCB via the SMARTS system in accordance with the requirements of Article XVI of the CGP, including but not limited to: a summary and evaluation of all sampling and analysis results, original laboratory reports, chain of custody forms, a summary of all corrective actions taken during the compliance year and identification of any compliance activities or corrective actions that were not implemented. The LRP will certify the annual report by September 1st. A project of 90 days or more duration can require more than one Annual Report. See below.

1. An Annual Report is required while the Project is still under construction, if construction begins not later than June 1 of a calendar year and is not completed by September 1 of that same year.

2. An Annual Report is required, without exception, prior to the September 1 following project completion.

   Example: A project commencing on May 31 and completed on September 2 of the same year would require an annual report both by September 1 of the reporting year, and prior Notice of Termination submittal.

F. Notice of Termination: Once construction is completed and the Site has been stabilized with final, sustainable cover, the Contractor shall prepare a Notice of Termination (NOT), including a final site map, photos, and a final project Annual Report, shall obtain necessary signatures from the LRP and shall submit all through the State Water Board's SMARTS website within 80 days after all land disturbing activities end and construction is complete. The LRP will certify the Notice of Termination within 90 days of all land disturbing activities end and construction is complete via SMARTS in accordance with Article II D of the CGP.

   A Notice of Termination is distinct from an Annual Report. Both are required.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials furnished for BMPs shall meet the requirements of the California Stormwater Quality Association, Stormwater Best Management Practice Handbook, Construction – November 2009 edition (or most current version) unless otherwise indicated.

B. Before the work begins, sufficient equipment shall be available on the site to assure that the operation and adequacy of the erosion control plans can be continuously maintained.

PART 3 EXECUTION

3.1 GENERAL DESCRIPTION

A. The Contractor shall install and maintain all pollution, erosion, and sediment control measures and carry out inspections in accordance the approved SWPPP/Good Housekeeping Plan.

B. Sediment transport and erosion from working stockpiles shall be controlled and restricted from moving beyond the immediately stockpile area by implementing applicable BMPs, including but not limited to construction of temporary toe-of-slope ditches and accompanying silt fences as necessary. If the BMPs proposed in the SWPPP prove inadequate to control sediment transport and erosion on the Site, the Contractor shall without delay implement additional provisions to obtain effective control. The SWPPP shall be updated to reflect the necessary changes as discussed in paragraph 1.6 above.

C. The Contractor shall be responsible for taking the proper actions to prevent contaminants and sediments from leaving the project Site. The Contractor shall take immediate action if directed by the Construction Manager/LRP, or if the Contractor observes contaminants and/or sediments entering the storm drainage system, to prevent further stormwater from entering the system.

3.2 NOTIFICATION AND REPORTING

A. If non-stormwater pollution occurs in the work area for any reason or when the Contractor becomes aware of any violation of this Section, the Contractor shall correct the problem and shall follow the requirements of the SWPPP for monitoring, control and reporting of non-stormwater discharges.

3.3 FIELD QUALITY CONTROL

A. The Contractor shall maintain the BMPs and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures.

Should the QSP note any deficiencies in necessary BMPs during the course of QSP's inspections and reporting, Contractor shall immediately repair or replace the defective BMPs as required by the QSP.

3.4 INSPECTIONS

A. The Contractor's QSP shall inspect disturbed areas of the construction site, areas that have not been finally stabilized, areas used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles are stored and/or exit the Site at least weekly, and in accordance with CGP storm event inspection requirements. The QSP shall perform quarterly inspections per CGP requirements.

B. The Contractor's QSP shall inspect discharge locations or points to ascertain whether BMPs are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the Site for evidence of offsite sediment tracking.

C. If required by the Project's Risk Level, Contractor's QSP shall conduct necessary Rain Event Monitoring, Sampling, and Reporting as required under the CGP.

D. Inspection Reports shall be in compliance with the requirements of the CGP for the specified Risk Level/LUP Type. Furnish the report to the Construction Manager, Engineer, and LRP within 24 hours of the inspection as a part of the Contractor's daily report or as a standalone report. A copy of the inspection report shall be maintained on Site.

3.5 RECORDS

A. The Contractor shall retain records/copies of data used to complete the PRDs; the SWPPP and all attachments and amendments; compliance certifications; notifications of non-compliance; training; incidents such as spills or other releases, including photographs as available; sampling and analysis of discharges discovered through visual monitoring; all reports required by the CGP; BMP inspections and checklists, and maintenance and repair activities; and activity-based BMPs, such as good housekeeping, that have been implemented.

B. After the work is complete and accepted by the Owner, submit to the Engineer and Owner all records/copies of documents required by the CGP, including, but not limited to, the records/copies of the documents noted above, and all documents uploaded to the SMARTS system.

3.6 MAINTENANCE OF TEMPORARY FACILITIES

A. Inspect erosion and sediment control structures daily, including site exit locations, and as specified in the SWPPP.

B. Sediment shall be removed from behind run off control structures after each storm, or as directed by the Engineer, LRP, QSD or QSP.

C. If areas are seeded, Contractor shall examine those areas during and after major storms to check that grass is becoming established.

3.7 DISPOSAL OF SEDIMENT FROM STORM WATER POLLUTION CONTROL STRUCTURES

A. Sediment excavated from temporary sediment control structures shall be disposed on the site with general fill or with topsoil. Sediment shall be allowed to dry out as required before reuse. All trash shall be removed before reuse.

B. Contractor shall place the sediment removed from traps and other structures where it will not enter a storm drain or water course and where it will not immediately reenter the basin.

3.8 REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES

A. In accordance with SWPPP requirements, temporary control measures shall be removed once all drainage area ground disturbance is completed, permanent drainage works have been constructed and full stabilization is achieved. Contractor shall not breach any temporary control structures until the associated catchment area is complete unless approved by the Engineer.

END SECTION

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SECTION 01 57 27

DUST CONTROL

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of implementing measures to prevent air pollution during construction activities, in accordance with Federal, State, and local regulations.

1.2 RELATED WORK

A. Division 2 – Existing Conditions

B. Division 31 – Earthwork

1.3 REFERENCES

A. San Joaquin Air Pollution Control District (SJVAPCD) Regulation VIII.

B. Dust Control Plan Fee, Pursuant to the adoption of Rule 3135, Adopted October 20, 2005 and subsequent revisions, compliance assistance bulletins and editions regarding Rule 3135 and PM 10 regulations.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures.

B. Submit, prior to beginning work and within 15 days of issuance of the Notice to Proceed a revised DCP.

1. Provide proof that the DCP has been submitted to the SJVAPCD for review and approval.

1.5 QUALITY ASSURANCE

A. Control the rate and effect of watering in such a manner as to avoid all objectionable settlement and subsidence as approved by the Engineer and to assure the integrity of the finished work.

B. Before commencing grading, excavation or filling in any part of the site, Contractor shall construct the required measures specified in the DCP.

C. Arrange demolition activities to minimize dust to the maximum practical extent. Clearing, excavation, and grading shall be limited to those areas of the Project site necessary for construction. Minimize the area exposed and unprotected.

D. Clearly mark and delineate the work limits activities. Equipment shall not be allowed to operate outside the limits of work or to disturb existing vegetation.

1.6 REGULATORY REQUIREMENTS

A. Contractor shall comply with all provisions of the SJVAPCD regulations, as well as Federal and State regulations.

B. The requirements of the Dust Control Plan shall apply continuously through the duration of the Contract.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Before the work begins, sufficient equipment and resources shall be available on the site to assure that the operation and adequacy of the dust control measures can be continuously maintained.

2.2 DUST CONTROL MEASURES

A. Dust Suppressants shall be polymer emulsions or hygroscopic suppressants. Petroleum emulsions and bituminous materials will not be allowed.

1. If dust suppressants other than water are utilized, Contractor shall submit SDS, Manufacturer's Usage Instructions, and certification by the manufacturer that the product is safe for ground application.

2. If dust suppressants other than water are utilized, contractor shall notify owner 15 days prior to use for notification to the SJVAPCD.

B. Gravel used for Gravel Pads shall be washed gravel, a minimum of one inch in diameter, and shall be placed a minimum of six inches deep.

PART 3 EXECUTION

3.1 GENERAL DESCRIPTION

A. Dust control measures shall include, but may not be limited to: Water application, dust suppressant application, physical barriers limiting site access, reduction of vehicle speed on site, utilization of gravel pads, utilization of grizzlies, and wheel washers. If physical barriers are utilized, the Engineer shall approve the location, size, and type. Physical barriers shall be removed upon project completion.

B. Furnish, install, maintain, and operate necessary control measures and other equipment necessary to prevent dust. Temporary measures shall be to Contractor's own design and Contractor shall be solely responsible for risks related to the management of dust control during construction.

3.2 METHODS

A. As described in the DCP and approved by the Engineer.

3.3 MAINTENANCE OF TEMPORARY FACILITIES

A. Inspect dust control facilities daily and as specified in the DCP.

B. Sediment shall be removed from grizzlies, gravel pads, and/or paved surfaces as required by the DCP, or as directed by the Engineer.

C. If areas are seeded, contractor shall examine those areas during or after major storms to check that grass is becoming established.

3.4 DISPOSAL OF SOIL FROM PAVED SURFACES AND DUST CONTROL DEVICES

A. Soil excavated from temporary dust control structures shall be disposed on the site with general fill or with topsoil. Soil shall be allowed to dry out as required before reuse. Any trash shall be removed before reuse.

B. Contractor shall place the sediment removed from traps and other structures where it will not enter immediately reenter the device or paved area.

3.5 REMOVAL OF TEMPORARY DUST CONTROL MEASURES

A. Temporary control measures shall be removed once grading is completed and soils have stabilized.

3.6 RECORD KEEPING

A. Contractor shall keep accurate records as required by the SJVAPCD of dust control methods utilized during the course of construction. The Contractor shall utilize the forms provided by the SJVAPCD, available on the SJVAPCD website.

B. Contractor shall keep a copy of the approved DCP, any approved revisions, and all dust control records at the site.

C. Contractor shall furnish upon request by the Owner, Engineer, or SJVAPCD Inspector the approved DCP, approved revisions, and dust control records.

D. Contractor shall maintain dust control records for one year after project completion.

3.7 DUST CONTROL

A. The Contractor shall take whatever steps, procedures, or means as are required to limit dust generated by his operations during the Work, including Saturdays, Sundays, and Holidays. Dust shall be controlled to the standards of the local governing agency or, in the absence of local standards, to the satisfaction of the Engineer. Dust control shall extend to any unpaved road which the Contractor or any of his subcontractors are using, to excavation or fill areas, to demolition operations, and to other activities. Control shall be by sprinkling, use of dust palliatives, modification of operations, or any other means acceptable to the local governing agency or, in the absence of same, the Engineer.

B. If the dust control is not adequate in the opinion of the Engineer, this work may be done by others, and the cost shall be deducted from the total payment due the Contractor.

END SECTION

SECTION 02 01 20

PROTECTION OF UNDERGROUND FACILITIES AND SURVEY MONUMENTS

PART 1 GENERAL

1.1 UNDERGROUND FACILITIES

A. Shown or Indicated*:* The information and data shown or indicated in the Contract Documents with respect to existing underground facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such underground facilities, including Owner, or by others.

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. The cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. Reviewing and checking all such information and data,

b. Locating all Underground Facilities shown or indicated in the Contract Documents,

c. Coordination of the Work with the owners of such underground facilities, including Owner, during construction, and

d. The safety and protection of all such underground facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated: If an underground facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated with reasonable accuracy in the Contract Documents, the following shall apply.

1. Contractor shall develop and execute a work-plan, subject to Engineer's approval to protect underground facilities.

2. The Contractor shall expose, prior to staking and trenching, all existing utilities and existing facilities which may control proposed facility grades, and alignment. Two working days notice shall be given to the Engineer prior to commencing this work.

3. Full compensation for all costs involved in locating, verifying, protecting, exposing, and otherwise providing for utilities shall be included in the amounts bid for the various items of work, and no separate payment shall be made therefore.

1.2 PROTECTION

A. The Contractor shall not interrupt the service function or disturb the supporting base of any Utility by disrupting any facility identified in the Plans and Specifications without authority from the Owner or order from the Engineer. Where protection of such facilities is required to ensure support of utilities, the Contractor shall, unless otherwise provided, furnish and place the necessary protection at the Contractor's expense.

B. The Contractor shall be prepared at all times with labor, equipment and materials to make repair on damaged mains or Utility facilities. The Contractor shall immediately notify the Engineer and the Utility owner if he disturbs, disconnects or damages any Utility. The Contractor shall bear the costs of repair or replacement of any Utility facility described with reasonable accuracy in the Plans and Specifications that is damaged by the Contractor. No extra compensation will be made for the repair of any services or mains damaged by the Contractor, nor for any damage incurred if the neglect or failure of providing protective barriers, lights and other devices or means required to protect such existing utilities or facilities described with reasonable accuracy in the Plans and Specifications.

1.3 SURVEY MARKERS AND PERMANENT REFERENCE POINTS

A. Surveying and Permanent Survey Markers

The Engineer will take measurements to assure the preservation of survey markers (monuments and bench marks). The Contractor shall not disturb permanent survey markers without the consent of Engineer and shall bear the expense of replacing any that may be disturbed without permission.

1. Replacement of survey markers shall be done only by the Engineer.

2. If disturbing of markers cannot be avoided, the Owner shall pay the cost of replacing said markers.

B. Lot Corner Monuments

The Contractor shall preserve property line and corner survey markers except where their destruction is unavoidable and the Contractor is proceeding in accordance with accepted practice. Markers that are lost or disturbed by his operations shall be replaced at the Contractor's expense by the Engineer.

END SECTION

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 DESCRIPTION

A. The work of this section consists of demolition and removal of pavements, slabs, miscellaneous debris, fencing, site piping, hose bibs, electrical equipment, concrete wall, potion of block wall building, and maintenance structure.

B. Definitions:

1. Portland Cement Concrete: A mixture of Portland cement, fine aggregate, coarse aggregate, admixtures (if used) and water, proportioned and mixed. Also, included is rebar.

2. Asphalt Concrete: A mixture of liquid asphalt and graded aggregate used as paving material for roadways and parking lots.

1.2 WORK INCLUDED

A. Repair and restoration of areas damaged due to demolition work.

B. Salvaging of equipment for Owner.

C. Removal of demolished materials from site.

D. Remove existing piping and other existing structures as shown on the Plans to be removed.

E. Properly dispose of all removed materials.

F. Dewatering as needed in order to complete the proposed demolition.

G. Removal of landscaping as required for construction.

1.3 REGULATORY REQUIREMENTS

A. All equipment that is demolished shall be reviewed by City staff for surplus prior to removal from site.

B. Dispose of removed materials in an approved disposal or salvage facility.

1.4 REFERENCES

A. Section 17-2 – Clearing and Grubbing, State Standard Specifications

B. Section 19 – Earthwork, State Standard Specifications

1.5 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures

B. Demolition plan including sequence of operations. The plan shall specifically address methods of demolition, schedule, sequence of demolition, and procedures for archeological monitoring. Demolition shall not proceed until the plan has been approved.

1.6 QUALITY ASSURANCE

A. General: Take all necessary precautions with regard to safety in carrying out the demolition and site work. Erect suitable barriers around open excavations and fulfill all appropriate requirements of CAL/OSHA. Comply with safety requirements for demolition, ANSI A10.6-90.

1.7 PROJECT CONDITIONS

A. Underground utilities exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.

B. Keep dust to a minimum at removal site and on haul roads. Use sprinklers or water trucks as necessary or as directed by the Engineer.

C. Ensure safety of persons in demolition area. Provide temporary barricades as required.

D. Excavations may encounter groundwater and require dewatering depending on the time of year and amount of seasonal run-off. Loose sands exposed in excavation sidewalls may be unstable and require shoring or lying back in accordance with OSHA requirements. Flowing sands may also be encountered in excavations below groundwater levels.

1.8 CLOSEOUT SUBMITTALS

A. Show all capped and abandoned utility terminations and location of remaining facilities on project Record Drawings.

PART 2 PRODUCTS

2.1 REPAIR AND RESTORATION MATERIALS

A. Concrete shall be as specified in Section 03 33 10 – Concrete Site Work.

B. Backfill materials shall be as required by Section 19 – Earthwork, State Standard Specifications.

C. Asphalt and concrete shall match existing materials and conditions.

D. Asphalt and concrete shall be replaced in conformance with governing authority standards.

2.2 MATERIALS

A. Salvaged Materials: Materials to be salvaged shall remain the property of the Owner and shall be stockpiled as directed by the Engineer. Contractor shall inventory all salvaged materials. Stockpiled materials shall be free of hazardous substances. Salvage materials include:

B. Items to be Salvaged and Relocated shall be salvaged and/or relocated as shown on the drawings, or as directed by the Engineer.

C. Materials and items demolished and not designated for reuse, salvage or transfer to the Owner, as well as all debris, rubbish and other materials resulting from the demolition operations, shall become the property of the Contractor and shall be removed from the site within 48 hours of demolition.

D. Storage or sale of the removed items will not be permitted at the site.

PART 3 EXECUTION

3.1 INSPECTION

A. Prior to demolition, inspect the site conditions, verifying all governing dimensions, notes and specification. Notify the Engineer of any errors or omissions in the contract documents.

B. Make such explorations and probes as are necessary to ascertain any required protection measures before proceeding with the demolition and removal work.

3.2 PREPARATION

A. Protect existing, appurtenances, structures, which are not to be demolished.

B. Prior to demolition work, all soil erosion control measures specified in Section 01 57 23 - Stormwater Pollution Prevention Plan (SWPPP) and inlet protection barriers shall be in place. Contractor shall provide appropriate measures to prohibit demolition debris and/or soil from entering any watercourse.

1. Protect all buildings, structures, utilities, and vegetation to remain.

3.3 DEMOLITION REQUIREMENTS

A. Conduct demolition to protect and minimize damage to structures and existing improvements.

B. Conduct salvaging to protect and minimize damage to salvaged equipment.

C. Execute the work in a careful, orderly and safe manner, with the least possible disturbance to the public. Cease operations immediately if adjacent work appears to be endangered. Do not resume operations until corrective measures have been taken.

D. Pavement and Slabs:

1. Remove completely all Portland cement concrete slabs-on-grade including, but not limited to, equipment pads, sidewalks, etc. If approved by the Engineer, the Contractor may crush Portland concrete for use as aggregate base.

2. Saw cut existing asphalt concrete pavements cleanly in straight continuous lines. Remove asphalt concrete pavement as shown on the drawings.

3. Any material thus processed shall conform to the specifications for Section 32 11 23 – Aggregate Base

4. In areas that are demolished, but where no future roads or structures are shown, the exposed subgrade shall be scarified an additional 18 inches before placing backfill.

E. Concrete and Masonry Structures: Remove structure to a minimum of 3 feet below grade. Break remaining portions to permit drainage. Remove completely if under proposed structures or roadways.

F. Items to be Salvaged: Remove as directed by the Engineer. Remove carefully. All salvaged material remains the property of the Owner. Store where directed by the Engineer.

G. Abandoned Utilities: Remove above ground utilities and terminate as approved by the utility company and the Engineer. Remove necessary portions of underground utilities to within 24 inches of excavation or final grade. Plug abandoned pipes and conduits with concrete plugs. Plugs shall be 6 inches or 2 times the pipe diameter in length, whichever is greater.

1. Water lines shall be capped as close as possible to active mains.

3.4 SALVAGE EQUIPMENT

A. Salvaged equipment shall be delivered to the Owner at a designated site within the project site. Salvaged equipment shall be placed on wood or concrete blocks so the equipment will be 4 inches minimum above ground elevation.

B. Equipment to be salvaged:

1. All pumps, including motors.

2. All electrical panels, including breakers, contactors, disconnects, fuses, relays and switches.

3. All threaded steel pipefittings 2 inch and larger.

4. Gate and fencing materials that are to be reused and relocated.

C. Electrical equipment items to be salvaged are covered in the electrical plans and specifications.

3.5 ORDER OF WORK

A. Coordination will be required with the Owner for temporary shut-off of existing pipeline system for connection of new pipeline to existing pipelines and new chlorination connection. Contractor shall submit plans to Owner for approval for shut-off duration at least 10 days prior to shut-off.

3.6 PRESERVATION

A. If indicated or required, preserve trees, plants, , or other features designated to remain. Protect trees and plants from damage; fell trees in a manner which shall not injure standing trees, plants and improvements which are to be preserved.

3.7 RESTORATION

A. All demolition areas, staging/stockpiling, and open excavations shall be filled in accordance with the Earthwork Sections. Fill all open excavations deeper than one foot to an elevation to match the surrounding topography.

1. New Construction Areas: As shown on drawings.

END SECTION

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SECTION 03 05 10

LEAKAGE TESTING OF HYDRAULIC STRUCTURES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This work described in this section includes leakage testing of concrete structures subject to hydrostatic pressure.

1.2 RELATED WORK

A. Section 03 30 10 – General Concrete Construction

B. Section 33 13 00 – Disinfection of Water System

1.3 REFERENCES

A. None

1.4 SUBMITTALS

A. Submit a testing schedule, including proposed plans for water conveyance, control, disinfection, and disposal in writing for approval a minimum of [14] days before testing is to start. The submittal shall include the methods to determine evaporation loss and the CONTRACTOR'S plan for the release of water from structures after testing and disinfection has been completed.

PART 2 PRODUCTS

2.1 MATERIALS

A. The Contractor shall furnish and install all temporary fittings and equipment required for the completion of the testing described herein.

B. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the Contractor. No materials shall be used which would damage the structure or its future intended function.

C. All leakage testing shall be conducted using water. Testing of structures designed to contain potable water shall be conducted using potable water.

PART 3 EXECUTION

3.1 PREPARATION

A. Except as otherwise indicated, potable water for testing will be furnished by the Contractor.

B. Contractor shall verify that concrete strength has attained at least 85 percent of its 28-day design strength prior to testing.

C. In the case of hydraulic structures designed to contain potable water, leakage testing may be combined with disinfection per Section 33 13 00.

D. Prior to testing, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.

E. Contractor shall verify that all valves or gates are fully closed and all pipe penetrations are temporarily plugged prior to conducting leakage test.

3.2 TESTING

A. Fill the structure to just below the overflow water level

B. Collect an initial water level reading. Collect a second water level reading seven days after the initial reading.

C. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the two water level readings, does not exceed 0.2 percent of the total volume of water in the structure, after allowance is made for evaporation loss.

D. If the structure fails to pass the leakage test, the Contractor shall empty the structure as acceptable to the Construction Manager and shall examine the exterior and interior for evidence of any cracking or other conditions that might be responsible for the leakage. Any cracks shall be repaired and sealed with polyurethane sealant in accordance with Section 03 30 10. Any evidence of leakage shall be repaired. Following these operations, the Contractor shall again test the hydraulic structure.

E. Wet spots or other apparent seepage on the exterior areas or the wall faces shall not be acceptable. Wet spots are defined as spots where moisture can be picked up on a dry hand. Any cracks or other areas of apparent leakage, including wet spots on the wall or wall footing, shall be sealed with sealant system compatible with the defective area or other means acceptable to the Engineer. Allow the joint to set and cure following the cement manufacturer's instructions. Do not load the joint for at least 8 hours after joint assembly.

END SECTION

SECTION 03 11 00

CONCRETE FORMWORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Work required under this section consists of furnishing all materials, supplies, equipment, tools, transportation, and facilities, and performing all labor and services incidental to furnishing and installing concrete formwork as described in this section of the Specifications, shown on the accompanying Plans, or reasonably implied therefrom. The work shall include, but is not necessarily limited to:

B. Scope:

1. Design of formwork, shoring and reshoring.

2. Furnishing, erection, and removal of forms.

3. Shoring and bracing of formwork.

1.2 REFERENCES

A. Industry Codes and Standards

1. American Concrete Institute (ACI) Manual of Concrete Practice

ACI 117	Standard Tolerances for Concrete Construction and Materials and Commentary
ACI 301	Specifications for Structural Concrete for Buildings
ACI 347	Guide to Formwork for Concrete

2. Western Wood Products Association (WWPA)

B. Government Regulations

1. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Regulations

   a. OSHA 29 CFR Part 1926.701 Safety and Health Regulations for Construction

2. Cal/OSHA Standards, Division of Industrial Safety, Construction Safety Orders, Article 29 Erection and Construction

   a. Section 1717 Falsework and Vertical Shoring

C. Where reference is made to one of the above, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS

A. As specified in Section 01 33 00 - Submittal Procedures.

B. Provide concrete construction joints and expansion joints of the types and locations indicated. Submit for approval shop drawings showing proposed location and type of required construction for any joints not shown on the Drawings, and sequence of forming and concrete placing operations.

C. Provide formwork, shoring and reshoring calculations for information only.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies. The requirements of California Division of Occupational Safety and Health, Construction Safety Orders Section 1717 and OSHA Part 1926, Section 1926.701 apply to the Work of this Section, and the Contractor shall prepare and maintain at least one (1) copy of the required drawings at the site. Design of the structures shown on the Drawings does not include any allowance or consideration for imposed construction loads. Provide forms, shoring and falsework adequate for imposed live and dead loads, including equipment, height of concrete drop, concrete and foundation pressures, stresses, lateral stability, and other safety factors during construction.

B. Standards and Tolerances. Employ formwork complying with ACI 347 Guide to Formwork for Concrete, except as exceeded by the requirements of regulatory agencies or as otherwise indicated or specified. Design and construct formwork to produce finished concrete conforming to tolerances given in ACI 117

1. Form offset shall meet the requirements of Class C.

PART 2 PRODUCTS

2.1 FORM COATING

A. Form coating compounds shall be biodegradable with a VOC level less than 50 grams/liter. Non-grain raising and non-staining resin or polymer type that will not leave residual matter on surface of concrete or adversely affect bonding to concrete of paint, plaster, mortar, protective coatings, waterproofing or other applied materials. Coatings containing mineral oils, paraffin, waxes, or other non-drying ingredients are not permitted. For concrete surfaces contacting potable stored water, use only coatings and form-release agents that are completely non-toxic.

2.2 LUMBER

A. WWPA Structural Light Framing No. 1 or Structural Joists and Planks No. 1, or equal. Board forms, if used, shall be No. 2 Common or better, T&G or shiplap, S1S2E, or better.

2.3 METAL FORM TIES

A. Provide commercially manufactured, prefabricated rod, snap-off, or threaded internal disconnecting type of tensile strength to resist all imposed loads. Use only ties that leave no metal within 1½-inch of concrete surfaces after removal. Employ snap-off type ties having integral washer spreaders of diameter to fully close tie holes in forms.

PART 3 EXECUTIONS

3.1 FORM TYPES

A. Smooth Surface Concrete. Use specified plywood or metal forms, as approved, for interior and exterior exposed above-grade concrete and all formed concrete in contact with liquids, waterproofing and protective coatings.

B. General Concrete. Use either plywood or board forms for concealed surfaces, or form as specified for smooth surface concrete.

3.2 SHORING AND FALSE WORK

A. Distribute loads properly over base area on which shoring is erected, either concrete slabs or ground; if on ground, protect against undermining or settlement, particularly against wetting of soils.

B. Alignment. Construct forms to produce in finished structure all lines, grades, and camber, as required.

3.3 FORM CONSTRUCTION

A. Build forms to exact shapes, sizes, lines, and dimensions as required to obtain accurate alignment, location and grades, and level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, chamfers, blocking, joint screeds, bulkheads, anchorages, and other required features. Make forms easily removable without hammering or prying against concrete. Use approved metal spreaders to provide accurate spreading of forms. Construct forms so that no sagging, leakage, or displacement occurs during and after pouring of concrete. Coat forms with specified coating material only prior to placement of reinforcing steel; do not allow coating to contact reinforcing bars.

B. Form Joints and Tie Holes. Seal joints between form panels with specified calking compound. Unless form tie spreaders fully seal tie holes in forms, seal around ties with specified materials and prevent leakage of concrete mortar.

C. Reuse. Clean and recondition form material before each reuse. Fill all holes, cracks and defects. Unsatisfactory material (in the opinion of the Construction Manager) shall be rejected and removed from the site.

D. Provide ¾" inch chamfers at all exposed outside corners. Use mill run chamfer strips surfaced all sides. Provide rounded top edges of sidewalks, walkways, and where directed.

3.4 ALLOWABLE VARIATIONS FOR FORMED SURFACES

A. Tolerances: Per ACI 301 requirements.

3.5 EMBEDDED PIPING AND ROUGH HARDWARE

A. Install electrical conduits per the direction of the electrical contractor as not to reduce the strength of the construction. Support embedded pipes and conduits independently from reinforcing steel in a manner to prevent metallic contact and thereby prevent electrolytic deterioration. Place embedded pipes and conduits as nearly as possible to the centerline of the concrete section. Submit all conduit, piping and other wall penetrations, reinforcements and anchor bolt sizing and locations to Owner's review and approval.

3.6 FIELD QUALITY

A. Inspection of Forms: Check forms prior to placement of any concrete for grade and alignment.

B. Control during Concrete Placement: Check forms during concrete placement and to promptly seal all mortar leaks and to correct all form movement or misalignment.

3.7 REMOVAL OF FORMS AND SHORING

A. Do not remove forms or shoring until concrete has attained sufficient strength to support its own weight and all imposed construction and permanent loads.

B. Form Removal. Minimum times for removal after concrete placement are as follows:

Beam sides but not shoring	3 days
Column forms and wall forms	2 days
Forms for supported slabs but not shoring	14 days

C. Shoring and Falsework Removal. Do not remove shoring and falsework until 21 days after concrete placement, or until concrete has attained at least 90 percent of the 28 day design compressive strength as demonstrated by control test cylinders, but in no event, not sooner than 14 days.

D. All form materials, during stripping of forms below finish grade, shall be removed and deposed of unless otherwise approved by the Engineer.

E. Restriction. Do not impose construction, equipment, or permanent loads on columns, supported slabs, or supported beams until concrete has attained the 28-day design compressive strength.

F. Concrete Curing During Removals. Refer to Section 03 39 00 of these Specifications.

END SECTION

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SECTION 03 15 20

ANCHOR BOLTS AND POST-INSTALLED ANCHORS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of furnishing and installing all materials and equipment and providing all labor necessary to complete the work shown on the drawings and/or listed below and all other work and miscellaneous items not specifically mentioned but reasonably inferred for a complete installation, including all accessories and appurtenances required for a completed system.

B. Cast-in-Place anchor bolts, anchor bolts and threaded rod anchors for epoxy grouting.

C. Expansion anchors to be installed in hardened concrete.

1.2 RELATED WORK

A. Section 03 30 10 – Concrete Site Work

B. Section 05 50 00 – Fabricated Metal

1.3 SUBMITTALS

A. As specified in Section 01300 – Submittal Procedures.

1.4 GENERAL

A. Unless otherwise specified or indicated on the drawings, all anchor bolts shall be cast-in-place bolts, shall have a diameter of at least 3/4 inch, and shall be headed and shall include a square washer a minimum of 1/4 inch thick and 2 inches square.

B. Expansion anchors and threaded rod anchors indicated or accepted in lieu of cast-in-place anchor bolts for equipment or structural framing shall have a diameter of at least 3/4 inch and shall be ICBO Evaluation Report listed.

1. Unless otherwise specified or indicated on the drawings, or approved by the Engineer, all other expansion anchors shall have a diameter of at least 1/2 inch.

PART 2 MATERIALS

2.1 MATERIALS

A. Nuts and washers for anchor bolts and expansion anchors shall be the same material as the bolts or anchors they are used with.

Application	Reference
A. Anchor Bolts and Nuts	
1. Carbon Steel	ASTM A307
2. Stainless Steel	IFI-104, Grade 304 or 316
3. Galvanized Steel	Carbon steel bolts and nuts; hot-dip galvanized, ASTM A153 and A385.
B. Threaded Rod Anchors and Nuts	
1. Carbon Steel	ASTM A307 or A36
2. Stainless Steel	IFI-104, Grade 304 or 316
3. Galvanized Steel	Carbon steel bolts and nuts; hot-dip galvanized, ASTM A153 and A385
C. Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.
D. Expansion Anchors	
1. For Concrete	Fed Spec FF-S-325; wedge type, Group II, Type 4, Class 1 or 2; self-drilling type, Group III, Type 1; or nondrilling type, Group VIII, Type 1 or 2; Hilti ICBO #3987 or 4627, ITW Ramset/Red Head ICBO #2391, Rawl Bolt ICBO #4514, or ICBO approved equivalent.
E. Adhesive Anchors	Hilti HIT RE-500 V3

B. Anchor bolts and threaded rod anchors for buried service and in splash zones shall be stainless steel. Anchor bolts, threaded rod anchors, and expansion anchors for immersion service shall be stainless steel. Expansion anchors for buried service and in splash zones shall be stainless steel. All other anchor bolts, threaded rod anchors, and expansion anchors shall be galvanized steel unless otherwise specified or indicated on the Plans.

PART 3 EXECUTION

3.1 ANCHOR BOLTS

A. Anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchor bolts which are cast in place in concrete shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or supporting template.

B. Anchor bolts and threaded rod anchors which are to be epoxy grouted shall be clean and free of coatings that would weaken the bond with epoxy.

C. Two nuts, a jam nut, and a washer shall be furnished for anchor bolts and threaded rod anchors indicated on the drawings to have locknuts; two nuts and a washer shall be furnished for all other anchor bolts.

D. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchor bolts and threaded rod anchors immediately before final installation and tightening of the nuts.

3.2 EXPANSION ANCHORS

A. Expansion anchors shall be installed in conformity with the manufacturer's instructions and ICBO Evaluation Report recommendations for maximum holding power, but in no case shall the depth of hold be less than four (4) bolt-hole diameters. The minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall be at least four and one half (4-1/2) times the diameter of the hole in which the anchor is installed. Unless otherwise indicated on the Plans, the minimum distance between the centers of the expansion anchors shall be at least eight (8) times the diameter of the hole in which the anchors are installed.

B. Anti-seize thread lubricant shall be liberally applied to threaded stainless steel components immediately before assembly.

END SECTION

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SECTION 03 30 10

CONCRETE SITE WORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Work required under this section consists of furnishing all materials, supplies, equipment, tools, transportation, and facilities, and performing all labor and services incidental to furnishing and installing concrete work as described in this section of the Specifications, shown on the accompanying Plans, or reasonably implied therefrom, except as hereinafter specifically excluded. The work shall include, but is not necessarily limited to:

1. All concrete placement and finishing.

2. Installation of all reglets, bolts, anchors, sleeves, etc., whether furnished under this section or by others .

3. The furnishing of all items required to be or shown on the Plans as embedded in concrete, which are not specifically required under other sections.

4. Setting headers and screeds for finishing and protecting concrete.

B. Where prior inspection and test of materials are required, documentary evidence, in the form of test reports, shall be furnished prior to the time the material is incorporated into the work. All rejected material shall be promptly removed from the premises.

1.2 RELATED WORK

A. Section 03 15 20 – Anchor Bolts and Post-Installed Anchors

B. Section 03 39 00 – Concrete Curing

1.3 REFERENCES

A. American Concrete Institute (ACI)

B. American Society for Testing and Materials (ASTM)

C. State Standard Specifications

D. California Building Code (CBC)

1.4 DEFECTIVE WORK

A. Work considered to be defective may be ordered, by the Engineer, to be replaced in which case the Contractor shall remove and replace the defective work at his

expense. Work considered to be defective shall include, but not be limited to, the following:

1. Concrete incorrectly formed, or not conforming to details and dimensions on the Plans or with the intent of these documents, or concrete the surfaces of which are out of plumb or level.

2. Concrete in which defective or inadequate reinforcing steel has been placed.

3. Concrete containing wood, cloth, or other foreign matter, rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the Plans.

4. Concrete below specified strength.

1.5 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures.

B. Provide material certificates, shop fabrication and placement drawings, and schedule for all reinforcing steel, imbedded items, form release and curing compounds.

C. The Contractor shall provide a proposed concrete placement plan (to minimize the effects of cracking and differential settlement) to the Engineer, and gain approval of said plan, prior to ordering of reinforcing steel. As a minimum this plan shall contain the layout of horizontal and vertical construction joints, spaced no greater than 30 feet apart (unless specifically approved otherwise by the Engineer), and a pour schedule for the individual slab and wall pours. All construction joints shall be sized in conformance with the Typical Longitudinal Keys Detail and shall contain water stops as shown on the Construction Joint with Waterstop Detail.

PART 2 PRODUCTS

2.1 CONCRETE

A. Concrete shall conform to Section 90 of the State Standard Specifications. Unless otherwise shown on the concrete note sheet or specified in other sections, all concrete shall contain not less than 611 pounds of Portland cement per cubic yard of concrete (6-1/2 sack) with a minimum 28-day compressive strength of 4500 psi.

1. Portland cement shall be Type II.

2. Water/cement ratio shall not exceed 0.45 (by weight).

3. Slump at placement shall be 4 inches +/- 1 inch.

B. Concrete used for thrust blocks shall contain not less than 517 pounds of Type II Portland Cement per cubic yard of concrete (5 1/2 sack) with a slump of 4 inches +/- 1 inch.

C. Concrete used for pipe encasement shall contain not less than 517 pounds of Type II Portland Cement per cubic yard of concrete (5 1/2 sack).

D. Slurry cement backfill used in lieu of compacted soil shall contain not less than 188-pounds of Type II Portland Cement per cubic yard of concrete (2 sack) and shall comply with Section 19 of the State Standard Specifications.

2.2 AGGREGATE

A. Aggregate for normal weight concrete shall conform to ASTM C33. Aggregates shall be free of dirt, clay balls, roots, bark and other deleterious substances and shall be thoroughly washed before use.

B. The combined aggregates for concrete shall conform to the grading limits for the one inch, maximum size specified in Section 90-1.02C(4)(d) of the State Standard Specifications, Combined Aggregate Grading.

2.3 WATER

A. Water shall be clean and free from injurious amounts of acids, alkalis, salts, oils, organic materials or other deleterious substances.

2.4 FLYASH

A. Fly Ash: ASTM C618, Class F

1. Type of fly ash shall be compatible with the type of cement and the intended use of the concrete.

B. The weight of fly ash conforming to ASTM C618 shall not exceed 25 percent of the total cementitious material.

2.5 ADMIXTURES

A. Air Entraining: ASTM C260

B. Water Reducing: ASTM C494, Type A or D

C. Accelerating: ASTM C494, Type C or E

1. No admixture containing any chloride ions is acceptable.

D. Retarding: ASTM C494, Type B or D

PART 3 EXECUTION

3.1 REINFORCING STEEL

A. Reinforcing shall comply with Section 03 20 00 – Concrete Reinforcement.

3.2 FORMS

A. Formwork shall conform with Section 03 11 00 Concrete Formwork.

3.3 PLACING

A. All concrete shall be placed before it has taken its initial set and shall be placed in horizontal layers and in such a manner as to avoid segregation. The concrete adjacent to the forms and joints shall be thoroughly consolidated with a vibrator operating at not less than 4,500 vibrations per minute.

1. Pumping equipment shall be of suitable type, without Y-sections, and with adequate pumping capacity.

2. Loss of slump in pumping shall not exceed $1^1/_2$ ".

3. Concrete shall not be placed through reinforcing that may cause separation of aggregates.

B. The concrete shall be deposited as nearly as possible in its final position. Drop chutes and elephant trunks shall be used on drops greater than 5 feet. Concrete shall be placed at such a rate that all concrete in the same lift will be deposited on plastic concrete. The concrete comprising each unit of work shall be placed in a continuous lift.

C. The Contractor shall notify the Engineer 24 hours (1 working day) prior to concrete placement.

1. The form work and reinforcing steel placement shall be approved by the Engineer prior to ordering concrete.

D. Form Removal. Minimum times for removal after concrete placement shall conform to 03 11 00 Concrete Formwork.

E. Construction Joints

1. At ends of the first concrete pour, provide forms that positively locate any waterstop. Ensure the end forms of walls are removable without releasing the side forms. Provide seals around reinforcement and water stop to prevent mortar leaks.

2. Overlap the hardened concrete of the first pour with forms for the second pour. Brace the ends of the forms against the hardened concrete to prevent joint offsets and mortar leakage. Align any exterior features required on the finished surface.

3.4 CONCRETE JOINTS

A. General

1. Provide joints:

a. As shown on the Drawings and as noted below in these Specifications.

b. As required for constructability

c. After favorable review of layout, sequence and concrete placement program.

2. Provide minimum curing times before the second placement:

a. 2 days after the first concrete placement at the joint.

b. 10 days after each adjacent concrete placement, for infill pours or checkerboard placement pattern.

B. Control Joints:

1. Space typical control joints in slabs on grade or suspended slabs not exceeding 10 feet, or as shown on the Drawings. Control joints shall not be provided in water containment structures.

2. If cast-in with the concrete, positively locate the preformed joint filler and hold rigidly in place during concreting.

3. If saw-cut, use a wheeled power saw as soon as the concrete surface is firm enough. Saw-cut control joints must be constructed within 8-hours after concrete placement. Fill the groove with sealant over a backer rod.

C. Construction Joints:

1. Produce quality concrete, with full continuity of reinforcing and water tightness across the joints.

2. Space typical slab joints not exceeding 30 feet in the direction of the transverse or secondary reinforcing, typically the smaller reinforcing nearer to the center of the slab thickness. Space typical vertical wall joints no more than 30 feet apart.

3. Provide all joints in walls and slabs, retaining liquids, or earth with 6-inch waterstops. Continue all reinforcing through the joint unless otherwise noted.

4. After the first concrete placement at the joint, do not walk on or disturb any reinforcing extending into the second placement area for at least 48 hours.

5. Before depositing new concrete on or against concrete that has hardened, clean and roughen the entire surface of the joint exposing clean coarse aggregate solidly embedded in mortar matrix. Provide typically 1/4-inch roughness or amplitude of the concrete surface measured from the top of the exposed aggregate to the bottom of pockets between stones.

6. Drench the prepared joint with clean water and remove prior to the concrete pour.

7. Use special care in vibrating adjacent to construction joints to ensure thorough consolidation of the concrete around the waterstops and against the hardened portion of the joint. Additional hand tamping may be required.

8. For joints that are shown on architectural drawings as having a continuous reveal or recess, leave the wood form or pour strip used to create the reveal or recess in place or re-insert before roughening. Prevent the next concrete placement from filling the reveal or recess.

D. Expansion Joints

1. Stop all steel reinforcing clear of the joint at each side.

2. Provide center bulb waterstop continuously around the joint in walls and slabs retaining liquids.

3. Prepare a smooth first concrete surface with all voids filled.

4. Provide preformed joint filler, securely fastened to the existing concrete as directed by the Manufacturer.

5. Install bond breaker and sealant after curing is completed and when directed.

E. Bonding to Pre-existing Concrete: Mechanically roughen the old surface to a 1/4-inch amplitude, as defined in construction joint paragraph above. Apply epoxy bonding material prior to concreting, as recommended by the manufacturer.

F. Waterstop

1. Restrict field splices to butt joints in straight runs. For PVC type, make by heat welding, using a splicing iron. For rubber, provide sleeve joints and glue. Follow the manufacturer's specifications.

2. Positively locate and support in the forms so that concrete may be placed, consolidated, and vibrated on both sides of the embedded portion without displacement of the waterstop and without causing voids in the concrete. Protect the outstanding portion from damage during the first concrete pour and clean and positively support prior to the second pour. Place, consolidate and vibrate the second pour without displacement of the waterstop and without causing voids in the concrete.

3.5 CONCRETE CURING

A. Exposed concrete surfaces shall be protected from premature drying in accordance with Section 03 39 00 Concrete Curing.

3.6 FINISHING

A. Defective and honeycombed surfaces shall be chipped back to such a depth to expose solid concrete. The surface shall be dampened and coated with a bonding agent and packed with mortar.

B. Concrete Finishes for Vertical Wall Surfaces:

1. Form facing material shall produce a smooth, hard, uniform texture.

   a. Use forms specified for surfaces exposed to view in accordance with the Plans and other Specification Sections.

2. At a minimum, repair the following surface defects:

   a. Tie holes

   b. Honeycombs deeper than ¼”

   c. Air pockets deeper than ¼”

   d. Rock holes deeper than ¼”

   e. Scabbing

3. Chip or rub off fins exceeding 1/8” in height.

4. Provide SF/ESF-3.0 finish and a smooth-rubbed finish for:

   a. Walls being waterproofed, painted, coated with some other material.

   b. Use at all exposed surfaces not specified to receive another finish.

C. Related Uniform Surfaces (Except Slabs):

1. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.

2. Float surface to a texture consistent with that of formed surfaces.

3. Continue treatment uniformly across unformed surfaces.

D. Concrete Finishes for Horizontal Slab Surfaces:

1. General: Tamp concrete to force coarse aggregate down from surface. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains. Dusting of surface with dry cement or sand during finishing processes not permitted.

2. Slab Finish shall be as follows:

   a. Surfaces intended to receive damp proofing or water proofing membranes: Float finish.

   b. Floors intended to receive floor coverings and interior rooms: Trowel finish.

c. Sidewalks, garage floors, drive-throughs and ramps: Broom finish.

d. Exterior slabs, platforms, steps and landings, exterior and interior pedestrian ramps and interior stairs and all process equipment areas, not covered by other finish materials: Broom finish.

3. Tolerance for finished surface shall not exceed SO F_F=35, SO F_L = 25.

4. No tolerance will be allowed that will result in the maximum running, or cross, slope exceeding the requirements of the Americans with Disabilities Act.

3.7 TESTING

A. Testing of concrete shall be as required by the Engineer and in accordance with ACI 301, Chapter 1.6.

1. All costs of initial testing will be paid by the Owner unless otherwise noted.

2. All costs involved, including those required by the Engineer, in retesting of concrete required because of a failure to meet these Specifications shall be at the expense of the Contractor.

3.8 WATERTIGHTNESS OF CONCRETE WORK

A. It is the intent of this Specification to obtain concrete and grout with homogenous structure, which when hardened will have the required strength, is watertight, and resistance to weathering.

3.9 HYDRAULIC TESTING OF STRUCTURES

A. It is the intent of this Specification to obtain concrete and grout with homogenous structure, which when hardened will have the required strength, watertightness, and resistance to weathering. Testing of structures shall be done in accordance with Section 03 05 10 Leakage Testing of Hydraulic Structures.

END SECTION

SECTION 03 33 15

CONCRETE WALKS, CURBS, GUTTERS AND DRIVEWAYS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of constructing concrete walks, drive approaches, curbs, sidewalks, and gutters.

1.2 RELATED WORK

A. Section 03 33 10 - Concrete Site Work

B. Section 31 23 00 - Earthwork

1.3 REFERENCES

A. Section 40 – Concrete Pavement, State Standard Specifications

B. Section 90 –Concrete, State Standard Specifications

C. ASTM C172 – Sampling Fresh Concrete

D. California Test 540 – Method for Making, Handling and Storage of Concrete

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures.

1.5 QUALITY ASSURANCE

A. Concrete testing will be the responsibility of the Owner. All costs of initial testing will be paid by the Owner unless otherwise noted. All costs involved in retesting of concrete required because of a failure to meet these Specifications shall be at the expense of the Contractor, including those required by the Engineer.

B. The Contractor shall cooperate by rerouting equipment or by temporarily closing the work area being tested.

1.6 PROJECT CONDITIONS:

A. Place concrete only when temperatures are above 35 degrees F, unless it is protected from freezing and approved in advance by the Engineer.

PART 2 PRODUCTS

2.1 CONCRETE

A. Materials: Materials, including cement, aggregates, water, and admixtures, shall meet the requirements of Section 90 of the State Standard Specifications.

1. Cement: Type II.

2. Coarse Aggregate: Maximum size, 1-inch for hand methods, 3/4-inch for slip-form construction, and 1/2-inch for extruded curbs. For machine placed concrete, Contractor may, with Owner's approval, modify the aggregate grading specified to meet the recommendations of the manufacturer of the machine.

a. Minimum Cement Content:

1) Sidewalks, curbs and gutters: Class “B” (5 sack).

2) Driveways and cross gutters: Class “A” (6 sack).

B. Slump:

1. Concrete Walks: Maximum 4 inches.

2. Curb and Gutter:

a. Hand Vibrated: Maximum 3 inches.

b. Slip-Formed: Maximum 2 inches.

C. Strength: 4,000 psi for Type “A” and 3,000 psi for Type “B” at 28 days.

D. Manufacture and Delivery: Measurement of materials, batching, mixing, transporting, and delivery shall be as specified in ASTM C94. Discharge concrete into forms within 1-1/2 hours after introduction of water to cement. When temperature of concrete is 85 degrees F or above, the time between introduction of water to cement and complete discharge of concrete into forms shall not exceed 45 minutes.

E. Air Entraining Admixture: ASTM C260.

F. Other admixtures complying with ASTM C494 or ASTM C618 may be used with approval of Engineer. No chlorides will be permitted.

2.2 EXPANSION JOINT FILLERS

A. ASTM D994, preformed bituminous type, 1/2-inch thick.

2.3 SURFACE RETARDANT

A. Rugasol S, manufactured by Sika Chemical Corporation, Lyndhurst, New Jersey, Top Stop by WR Meadows, or approved equal.

2.4 CURING COMPOUND

A. In accordance with Section 90 of the State Standard Specifications.

2.5 CURING MATERIAL

A. Waterproof paper, polyethylene sheet, clean burlap, cotton mats, or other approved material that will not cause stain or discoloration.

B. Using curing compound or curing materials, thoroughly cure and protect concrete keeping the surface moist for 7 days. Cure slabs with integral color in accordance with instructions of the pigment manufacturer. On exposed aggregate slabs or slabs with integral color, do not use polyethylene or paper sheeting.

PART 3 EXECUTION

3.1 PREPARATION OF SUBGRADE

A. Excavate to required depth. Remove soft, yielding material and replace with select fill. Compact to a density of not less than 95 percent of the maximum density.

3.2 MAINTENANCE OF SUBGRADE

A. Maintain subgrade in a compacted condition until concrete is placed.

3.3 FORMS

A. Metal or uniform warp-free lumber, coated with form release agent. Grade forms to give slabs positive drainage and stake securely. Obtain approval of alignment and grade before placing concrete.

3.4 PLACING

A. Concrete slabs for walks shall be formed, placed, vibrated, and finished by hand using conventional methods. Concrete curbs or curbs and gutters may be constructed in the same manner, but Contractor has the option of machine placing curbs using the extrusion method or machine placing curb and gutter using the slip-form method.

B. Place concrete on moistened subgrade monolithically between construction joints. Deposit to full depth in one operation. Consolidate immediately. After depositing concrete, screed and darby or bullfloat.

3.5 FORM REMOVAL

A. Remove forms within 24 hours after concrete placement. Repair minor defects with mortar. Plastering will not be permitted on exposed faces.

3.6 SLAB FINISHING

A. After darbying or bullfloating, stop finishing until bleeding has ceased and until concrete can support foot pressure with only about 1/4-inch indentation. Edge and joint, then float the slab. Use steel trowel to densify surface, then broom slab perpendicular to line of traffic.

3.7 EXPOSED AGGREGATE FINISHING

A. Clean and thoroughly wet surface aggregate before use and drain to prevent free water from entering the concrete.

B. Evenly distribute aggregate by hand, covering surface with a single layer.

C. Embed the surface aggregate by patting with the flat side of a strike-off board or another tool.

D. When surface is firm, lightly hand float with a float or darby.

E. Spray retardant on the surface according to manufacturer's recommendations.

F. When the concrete has set up sufficiently, expose aggregate by simultaneously brushing and flushing with water without overexposing or dislodging the aggregate. Expose aggregate to a depth of 1/8 to 1/4 inch.

3.8 JOINTS

A. Construct joints true to line with faces perpendicular to surface.

1. Isolation Joints: Separate walks from walls, stairways, and other structures, using expansion joint fillers.

2. Contraction (Control) Joints: Space joints at intervals about equal to width of walk to a depth of one-fourth the slab thickness. Space curb and gutter joints not over 12 feet 6 inches on center and align them with sidewalk joints. Contraction joints may be either sawn or tooled.

a. Sawn: Cut with a power saw fitted with an abrasive or diamond blade within 4 to 12 hours after walk has been placed and finished. Use sawn joints on exposed aggregate.

b. Tooled: Form plane of weakness by inserting and later removing a metal divider, finish with an edger or a groover, or by saw cutting a previously tooled joint.

3.9 SIDEWALK RESTORATION

A. Where sections of miscellaneous sidewalk work require removal and restoration the following shall apply:

1. The surface of the sidewalk shall match the existing weakened plane joints, score joints and construction joint patterns with the adjoining sidewalks or City or County standards.

2. Where short sections of sidewalk have been removed for replacement, a minimum distance of three (3) feet section of sidewalk shall be removed or as directed by the Engineer.

3. If curbs and gutters cannot be cut off square and neat, the entire curb and gutter shall be removed to the nearest weakened plane or expansion joint. No patching at joints will be permitted.

3.10 FIELD QUALITY CONTROL

A. Surfaces shall not vary more than 5/16 inch when tested with a 10-foot straightedge, nor curb gutters and valley gutters shall not vary more than .03 feet from design grade.

END SECTION

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SECTION 03 39 00

CONCRETE CURING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Work required under this section consists of furnishing all materials, supplies, equipment, tools, transportation, and facilities, and performing all labor and services incidental to concrete curing.

1.2 RELATED WORK

A. Division 3 – Concrete

1.3 REFERENCES

A. State Standard Specifications, latest edition with amendments.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures.

PART 2 PRODUCTS

2.1 METHODS OF CURING

A. Newly placed concrete shall be cured by the methods specified in Section 90-1.03B of the State Standard Specifications (SSS).

1. 90-1.03B(2), Water Method
2. 90-1.03B(3), Curing Compound Method
3. 90-1.03B(4), Waterproof Membrane Method
4. 90-1.03B(5), Forms-In-Place Method

PART 3 EXECUTION

3.1 CURING

A. Exposed concrete surfaces shall be protected from premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap, sand or other satisfactory materials and kept continuously moist; or, if the surfaces are not covered, they shall be kept continuously moist by flushing or sprinkling. Curing shall continue for a period of not less than 7 days after placing the concrete.

B. If curing compound is used, it must be nontoxic and taste and odor free, and provide a paintable concrete surface. Curing compound shall include a dye and two (2) applications shall be made to insure coverage. Curing materials and methods require approval by the Engineer prior to use.

3.2 CURING PAVEMENT

A. The entire exposed area of the pavement, including edges, shall be cured by the waterproof membrane method, or curing compound method using curing compound (1) or (2) as the Contractor may elect. Should the side forms be removed before the expiration of 72 hours following the start of curing, the exposed pavement edges shall also be cured. If the pavement is cured by means of the curing compound method, the saw-cut and all portions of the curing compound that have been disturbed by sawing operations shall be restored by spraying with additional curing compound.

B. Curing shall commence as soon as the finishing process provided in Section 40-1.03M, "Final Finishing," has been completed. The method selected shall conform to the provisions in SSS Section 90-1.03B, " Curing Concrete."

C. When the curing compound method is used, the compound shall be applied to the entire pavement surface by mechanical sprayers. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator that provides for continual agitation of the curing compound during the time of application. The spray shall be adequately protected against wind, and the nozzles shall be so oriented or moved mechanically transversely as to result in the minimum specified rate of coverage being applied uniformly on exposed faces. Hand spraying of small and irregular areas, and areas inaccessible to mechanical spraying equipment, in the opinion of the Engineer, will be permitted. When the ambient air temperature is above 60°F (15°C), the Contractor shall fog the surface of the concrete with a fine spray of water as specified in SSS Section 90-1.03B(2), "Water Method." The surface of the pavement shall be kept moist between the hours of 10:00 a.m. and 4:30 p.m. on the day the concrete is placed. However, the fogging done after the curing compound has been applied shall not begin until the compound has set sufficiently to prevent displacement. Fogging shall be discontinued if ordered in writing by the Engineer.

3.3 CURING SLOPE PROTECTION

A. Concrete slope protection shall be cured in conformance with any of the methods specified in Section 90-1.03B, " Curing Concrete."

B. Concreted-rock slope protection shall be cured in conformance with any of the methods specified in Section 90-1.03B, " Curing Concrete," or with a blanket of earth kept wet for 72 hours, or by sprinkling with a fine spray of water every 2 hours during the daytime for a period of 3 days.

3.4 CURING MISCELLANEOUS CONCRETE WORK

A. Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in SSS Section 90-1.03B(3), "Curing Compound Method."

B. Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in SSS Section 90-1.03B, "Curing Concrete."

C. Shotcrete shall be cured for at least 72 hours by spraying with water, or by a moist earth blanket, or by any of the methods provided in SSS Section 90-1.03B, "Curing Concrete."

D. Mortar and grout shall be cured by keeping the surface damp for 3 days.

E. After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, or by a moist earth blanket, or by any of the methods provided in SSS Section 90-1.03B, "Curing Concrete."

END SECTION

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SECTION 05 05 20

BOLTS, WASHERS, ANCHORS AND EYEBOLTS

PART 1 GENERAL

1.1 WORK INCLUDED

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

1.2 DESIGN CRITERIA

A. Structural Connections: AISC Specification for Structural Steel Buildings (June 22, 2010), except connection details are shown in the Drawings.

1.3 REFERENCES

A. American Institute of Steel Construction (AISC)

B. American Society for Testing and Materials (ASTM)

C. Research Council on Structural Connections (RCSC)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.

B. Submit manufacturer's catalog data and ICC Evaluation Service Reports for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.

C. Submit anchor bolt layout drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. Anchor bolts, drilled anchors and epoxy anchors for buried service, immersion service and in splash zones shall be stainless steel. All other anchor bolts, drilled anchors and epoxy anchors shall be galvanized steel unless otherwise specified on the Plans.

2.2 ANCHOR BOLTS

A. Steel anchor bolts shall conform to ASTM F1554, Grade 36, Class 1A or 2A unless otherwise indicated. Size, length and thread length shall be as shown on the Drawings.

B. Bolts shall be provided with a head and two washers of a minimum of ¼ inch thick and 2 inches square. One washer shall be embedded in the concrete at the head of the bolt.

C. Anchor bolts, nuts and washers shall be galvanized per ASTM F2329.

2.3 CONNECTION BOLTS

A. Steel connection bolts shall conform to ASTM A325, Type 1 with the threads included in the shear plane.

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

2.4 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall be ASTM A193, Grade B8 or ASTM F593, Type 316. Nuts shall be ASTM A194, Grade 316 or ASTM F594, Type 316. Use ASTM A194 nuts with ASTM A193 bolts; 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.

2.5 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

A. Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Huskey™ Lube-O-Seal by HUSK-ITT Corporation, or equal.

2.6 WASHERS

A. Washers for bolts conforming to ASTM F1554 shall conform to ASTM F436, Type 1.

B. Washers for bolts conforming to ASTM A307 shall conform to ASTM F844.

C. Washers for bolts conforming to ASTM A325 shall be square or rectangular, tapered in thickness, smooth, hot-dipped galvanized, conforming to ASTM F436.

D. Stainless steel washers shall be Type 316.

2.7 DRILLED ANCHORS

A. Unless otherwise indicated in the Drawings, drilled anchors shall be 316 stainless steel wedge anchors as manufactured by ITW Red Head Trubolt+, Kwik Bolt TZ by Hilti, or equal. Anchors shall have ICC-approved testing.

2.8 EPOXY ANCHORS

A. Epoxy anchors in concrete shall be 316 stainless steel threaded rod adhesive anchors. Adhesive shall be ITW Red Head Epcon S7, Hilti HIT RE 500-SD, or equal. Epoxy anchor assemblies shall be ICC approved.

B. Epoxy anchors in grouted concrete masonry walls shall be 316 stainless threaded rods. Epoxy adhesive shall be Hilti HIT HY 70, Simpson ET-HP, or equal.

PART 3 EXECUTION

3.1 STORAGE OF MATERIALS

A. 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.

3.2 GALVANIZING

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

3.3 INSTALLING CONNECTION BOLTS

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

B. Install ASTM A325 bolts and washers per the RCSC "Specification for Structural Joints Using High Strength Bolts".

C. 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.

D. Slotted holes, if required in the Drawings, shall conform to AISC 360-10, Chapter J, Section J3, Table J3.3.

E. 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.

F. 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.

3.4 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

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

3.5 INSTALLING ANCHOR BOLTS

A. Anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchor bolts which are cast in place in concrete shall be provided with

sufficient threads to permit a nut to be installed on the concrete side of the concrete form or supporting template.

B. Preset bolts and anchors by the use of templates. Do not use concrete anchors set in holes drilled in the concrete after the concrete is placed for mechanical equipment. Anchor bolts and threaded rod anchors which are to be epoxy grouted shall be clean and free of coatings that would weaken the bond with epoxy.

C. Two nuts, a jam nut, and a washer shall be furnished for anchor bolts and threaded rod anchors indicated on the drawings to have locknuts; two nuts and a washer shall be furnished for all other anchor bolts.

D. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchor bolts and threaded rod anchors immediately before final installation and tightening of the nuts.

E. For static items such as storage tanks, use preset anchor bolts or drilled anchors with ICC report data.

F. 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.

3.6 INSTALLING DRILLED ANCHORS

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

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

3.7 INSTALLING EXPOXY ANCHORS

A. Epoxy anchors shall be clean and free of coatings that would weaken the bond with epoxy.

B. Minimum depth of embedment of epoxy anchors shall be as recommended by the manufacturer, but no less than that shown in the Drawings.

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

END SECTION

SECTION 05 50 00

FABRICATED METAL

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide metals work for fencing, bearing plates for pumps, and other miscellaneous metal works, complete as indicated, specified and required.

1. Steel channel and/or angle frames and thresholds with anchors

2. Handrails, stairs and grating

3. Pipe supports with saddles, hangers, bracing and attachments as detailed and required, except as provided by other trades

4. Guard post assemblies for removable and stationary types

5. Miscellaneous iron and steel items indicated, specified, or required for completion of the Work, unless included under other Sections of the Specification

6. Miscellaneous connections, anchors, bolts, clips, spacers, nuts, washers, shapes and inserts, as required

7. Galvanizing, shop primer finishes for work of this Section as specified or required, including field touchups.

1.2 RELATED WORK

A. Section 03 15 20 – Anchor Bolts and Expansion Anchors

B. Section 03 30 10 – Concrete Site Work

C. Section 09 90 00 – Painting

1.3 REFERENCES

A. Industry Codes and Standards

American Institute of Steel Construction (AISC)

Specification for the Design, Fabrication and Erection of Steel for Buildings

Code of Standard Practice for Steel Buildings and Bridges

American Society for Testing and Materials (ASTM)

American Welding Society (AWS)

AWS D 1.1 Structural Welding Code Steel

B. Government Regulations

U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)

Cal/OSHA Standards

1.4 QUALITY ASSURANCE

A. Unless otherwise specified all work specified herein and shown on the Drawings shall conform to the applicable requirements of the following specifications and codes:

1. Fabricate and erect miscellaneous metal work in accordance with the latest edition of the AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings," and "Code of Standard Practice for Steel Buildings and Bridges."

2. Inspections. Perform all field welding and field high strength bolting of structural steel assemblies under the inspection of the Engineer. Notify the Engineer at least 48 hours in advance of needed inspections. Provide copies of testing and inspection reports to the Engineer.

1.5 SUBMITTALS

A. Furnish submittals, samples and material data in conformance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings and Erection Drawings. Show materials and specification list, construction and fabrication details, layout and erection diagrams and method of anchorage to adjacent construction. Give location, type, size and extent of welding and bolted connections and clearly distinguish between shop and field connections. Coordinate shop drawings with related trades to ensure proper mating of assemblies.

a. Catalog work sheets showing illustrated cuts of item to be furnished, scale details and dimensions may be submitted for standard manufactured items.

b. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from Drawings. Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and direction necessary to permit other trades to properly locate their work. Where welded connectors, concrete, or masonry inserts are required to receive work, show on shop drawings exact locations required.

2. Shop Painting Data. Submit product list with product data sheets of intended shop coats. These products shall be compatible with the products and manufacturers with those systems Specified in Section 09 90 00 - Painting.

PART 2 PRODUCTS

2.1 MATERIALS – GENERAL

A. Provide materials that are new, sound and conforming to the following:

Item	**ASTM Standard No.**	**Class, Grade Type or Alloy No.**
Cast Iron		
Cast Iron	A48	Class 40B
Steel		
Galvanized sheet iron or steel	A653	Coating G90
Black steel, sheet or strip	A569 A570	--
Coil (plate)	A635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes)	A36	--
Rolled W shapes	A992	Grade 50
Standard bolts, nuts and washers	A307	--
High strength bolts, nuts and hardened flat washers	A325 A490	--
Eyebolts	A489	Type 1
Tubing, cold-formed	A500	--
Tubing, hot-formed	A501	--
Steel pipe	A53	Grade B
Stainless steel		
Plate, sheet and strip	A240	Type 304* or 316**
Bars and shapes	A276	Type 304* or 316**

Aluminum		
Flashing sheet aluminum	B209	Alloy 5005-H-14, 0.032 inches minimum thickness
Structural sheet aluminum	B209	Alloy 6061-T6
Structural aluminum	B209 B308	Alloy 6061-T6
Extruded aluminum	B221	Alloy 6063-T42

*Use Type 304L if material will be welded

**Use Type 316L if material will be welded

1. Anchor bolts:

    a. Anchorages for all locations unless otherwise indicated on Drawings: Stainless steel, Type 316, Hilti HVA adhesive anchors, or Engineer approved equivalent.

    b. Chemical bond or adhesive type DBDs, if approved by the manufacturer and the Engineer, are acceptable for anchorage of vibrating machinery or equipment.

2. Expansion Anchors.

    a. Hilti Kwik-Bolt, Standard Type or Engineer approved equivalent.

3. Galvanizing.

    a. Iron and Steel. ASTM A123, with average weight per square foot of 2.0 ounces and not less than 1.8 ounces per square foot.

    b. Ferrous Metal Hardware Items. ASTM A153 with average coating weight of 1.3 ounces per sq. ft.

    c. Touch-up Material for Galvanized Coatings. Repair galvanized coatings marred or damaged during erection or fabrication by use of DRYGALV as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or Engineer approved equivalent.

4. Welding Electrodes. Use welding electrodes conforming to AWS D1.1.

5. Shop Prime Paint. To assure compatibility with deferred field-applied paint or coating systems, for ferrous metals other than stainless steel, galvanized steel and cast iron, provide surface preparations and use shop prime paint product and manufacturer as painting or protective coating system intended for field application specified in Section 09 90 00 - Painting.

    a. Do not shop prime portions of work immediately adjacent to intended field welds, or portions intended for embedment.

PART 3 EXECUTION

3.1 GENERAL FABRICATION AND INSTALLATION REQUIREMENTS

A. Standards: Thoroughly clean ferrous metals of all loose scale and rust before being fabricated. Provide finished members free of twists, bends or open joints, and that present a neat workmanlike appearance when completed. Perform steel work conforming to the best practices set forth in the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

1. Perform aluminum work conforming to the applicable requirements of "Specifications for Aluminum Structures, Aluminum Construction Manual" of the Aluminum Association.

B. Welding: Perform all welding in accordance with the "Structural Welding Code-Steel," AWS D1.1.

1. Use only welders qualified by tests in accordance with AWS B 3.0.

C. General Fabrication and Installation

1. Using new stock of sizes specified or detailed, fabricate in shop producing high grade metal work. Form and fabricate to meet required conditions. Include clips, straps, bolts, screws, and other fastenings necessary to secure the work. Accurately make and tightly fit joining and intersections in true planes with adequate secure fastenings. Erect all metal work plumb, true on line and in its designated location. Grind and finish smooth field welds on exposed surface. Bolt or weld connections as indicated on Drawings. After installation, leave all work in a neat and clean condition, ready for field painting or coating.

a. The maximum misalignment tolerance for railing shall be 1/8 inch in 12 feet. Bent, deformed or otherwise damaged railings shall be replaced.

2. Coordinate work of this Section with related trades. Particular attention is required for items to be embedded in concrete work. Provide all punching and drillings indicated or required for attachment of other work to that of this Section.

3. Compliance with Safety Requirements: Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangers and etc. which are not shown on the Drawings, shall conform to the requirements of the Division of Occupational Health and Safety.

D. Protection

1. Provide protection and repair of adjacent surfaces and areas which may become damaged as a result of work of this Section. Protect work performed hereunder until completion and final acceptance of project by the Owner.

Repair or replace all damaged or defective work to original specified condition, at no additional cost to the Owner.

E. Painting

1. Apply all products in strict conformance with manufacturer's printed instructions.

2. Provide one or more shop coats of paint on all ferrous metals, except cast-iron, ductile iron, stainless steel and galvanized metals. Before priming, thoroughly clean surfaces. Allow shop coats to dry before materials are loaded for delivery to the job site. After erection, paint all areas where the shop coats have been rubbed off or omitted.

   a. See Section 09 90 00 - Painting of these specifications for surface preparation, prime coatings, finish painting and coatings.

3. Isolate aluminum members from contact with dissimilar metals, concrete and masonry to provide protection from electrolytic deterioration. Use non-absorptive tape or gaskets, heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle; or apply a heavy coat of approved alkali-resistant bituminous paint.

END SECTION

SECTION 05 52 00

HANDRAILING & LADDERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of furnishing and installing all materials and equipment and providing all labor necessary to complete the work shown on the drawings and/or listed below and all other work and miscellaneous items not specifically mentioned but reasonably inferred for a complete installation, including all accessories and appurtenances required for a completed system.

1.2 RELATED WORK

A. Section 03 15 20 – Anchor Bolts & Expansion Anchors

B. Section 05 50 00 – Structural Steel & Misc. Metals

C. Section 09 90 00- Painting

1.3 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures

PART 2 PRODUCTS

2.1 HANDRAILING

A. Railings shall conform to current local, state and OSHA standards and requirements. Railings shall be constructed of aluminum steel and installed as indicated in the Plans.

B. All welding of aluminum shall be done in accordance with the recommendations of the American Welding Society. Welds shall be free of porosity, cracks, holes and flux. All fasteners used shall be stainless steel.

C. Aluminum railings shall be fabricated from 1 ½ inch Schedule 40 pipe, or shall be prefabricated aluminum railings by Enerco “Alumarail”, Universal “Uni-Rail” or equal. Railings shall be provided with mill finish, clear anodic finish AA-MIOC20A41. All fabricated railings shall be provided with the manufacturer’s standard clear anodic A41 finish.

2.2 LADDERS

A. Ladders, safety cages, and rest platforms shall be provided where indicated on the drawings. For ladders made of fiberglass, see fiberglass fabrication section. When required, ladders shall be designed by the ladder supplier. The design shall comply with the latest issue of OSHA/ANSI A14.3 and the applicable building code

standards for ladders. Ladders and safety cages shall be fabricated with general configurations as indicated on the drawings. All necessary brackets, bolts, and anchors shall be provided. Ladder brackets shall be of the same materials as the ladder. Bracket connection bolts shall be galvanized steel for steel ladders and stainless steel for aluminum, stainless steel, or fiberglass ladders. Bracket anchors to concrete and masonry shall be stainless steel and as indicated on the drawings.

2.3 STAIRS

A. Stairs shall be fabricated to the dimensions, arrangements, sizes, and members indicated on the drawings. For stairs made of fiberglass, see fiberglass fabrication section. Stairs shall be true to line and slope, accurately mitered and joined, and securely and rigidly supported.

2.4 STAIR DESIGN

A. When required, stairs shall be designed by the stair supplier. The design shall comply with all applicable provisions of the local building code, ANSI A117.1, and OSHA as applicable. The design shall be sealed by an engineer registered in the state of the project. Calculations shall be submitted for review when required.

B. The completed fabrications shall support a uniform live load of 100 lbs per square foot and a concentrated load of 300 lbs applied at the center of the span. Individual treads and platforms shall be designed to support a uniform live load of 100 lbs per square foot or a 300 lb concentrated live load applied on an area of 4 square inches. Vertical deflections under full live load shall be limited to span/240. Stairs and landings shall be braced or otherwise designed to avoid noticeable side sway.

C. The stair design and details shall be coordinated with the hand railing and guard railing supplied. Stair members shall be adequate to accept loads from the rail posts based upon the following minimum railing design criteria.

1. 200 lbs applied at any point and in any direction on the top of each rail post.

2. 50 lbs per lineal foot applied in any direction on the handrail.

3. 50 lbs per lineal foot applied horizontally at the required guardrail height simultaneously with 100 plf applied vertically downward at the top of the guardrail.

D. Connections to the supporting structure shall be adequate to transfer all loadings with a factor of safety of at least three times service load. The number and type of connections shall comply, at a minimum, with the design drawings. All necessary brackets, bolts, and anchors shall be provided.

2.5 PAN TYPE STAIRS

A. Risers and subtreads shall be fabricated from 12 USS gage steel and subplatforms from 10 USS gage steel. Fill depth shall be 2 inches for treads and 3 inches for platforms, or as otherwise required. Each riser shall have a formed sanitary cove,

located so that the toe of the cove will be at the surface of the concrete fill or applied finish, and an integral non-slip nosing.

2.6 GRATING STAIRS

A. Risers shall be fabricated from grating material in accordance with the specification for grating and trench covers.

2.7 CHECKERED PLATE STAIRS

A. Risers and subtreads shall be fabricated from checkered plate as indicated on the details on the drawings.

2.8 NOSINGS

A. All stair treads shall have non-skid nosings, either fabricated integrally with the tread or attached with stainless steel bolts and self-locking nuts.

2.9 SHOP COATING

A. All structural and miscellaneous metal items shall be shop coated as specified herein. The requirements for field painting are covered in the protective coatings, Section 09 90 00 – Painting.

B. Surfaces shall be dry and of proper temperature when coated, and shall be free of grease, oil, dirt, dust, grit, rust, loose mill scale, weld flux, slag, weld spatter, and other objectionable substances. Articles to be galvanized shall be pickled before galvanizing. All other ferrous metal surfaces shall be cleaned by high-speed power wire brushing or by blasting to the extent recommended by the paint manufacturer. Welds shall be scraped, chipped, and brushed to remove all weld spatter.

C. Sharp projections of cut or sheared edges of ferrous metals which will be submerged in operation, except for items specified to be hot-dip galvanized, shall be ground to a radius as needed to ensure satisfactory paint adherence.

D. All galvanizing shall be done by the hot-dip process after fabrication. An approved zinc-rich paint shall be used to touch up minor coating damage. Materials with significant coating damage shall be regalvanized or replaced.

E. Where galvanized bolts are indicated on the drawings or specified, the use of zinc-plated bolts will not be acceptable.

2.10 PRIME PAINTED STEEL

A. Unless otherwise specified or indicated on the drawings, all ungalvanized structural and miscellaneous steel shall be given a universal prime coat in the shop after fabrication. Red oxide primer may be substituted for the specified universal primer only if specifically permitted in the data sheet. Special primers may be required for certain steel materials as indicated on the drawings. Steel surfaces shall be prime-coated as soon as practicable after cleaning. Steel shall not be moved or handled until the shop coat is dry and hard.

B. The dry film thickness of the shop coating shall be at least 2 mils for universal primer or red oxide primer and at least 5 mils for epoxy enamel. The dry film thickness of special primers shall be as recommended by the manufacturer.

2.11 ALUMINUM

A. All surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a coat of epoxy enamel.

2.12 STAINLESS STEEL

A. Unless otherwise specified or permitted, all items fabricated from stainless steel shall be thoroughly cleaned and degreased after fabrication. Pickling or a light blast cleaning shall produce a modest etch and remove all embedded iron and heat tint. Surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron and shall be retreated as needed to remove all traces of iron contamination. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

B. Painting of zinc coated steel or bronze surfaces will not be required.

2.13 FINISH PAINTED STEEL

A. Steel materials specifically indicated on the drawings shall be finished painted after priming prior to delivery to the job site. Color shall be selected by Engineer.

PART 3 EXECUTION

3.1 GENERAL

A. Materials shall be erected and installed in conformity with dimensions, and arrangements specified or indicated on the drawings.

B. All members and parts, as erected, shall be free of winds, warps, local deformations, and unauthorized bends.

C. Before assembly, surfaces to be in contact with each other shall be thoroughly cleaned. All parts shall be assembled accurately as indicated on the drawings.

D. Light drifting will be permitted to draw parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done only with the approval of Engineer by reaming with twist drills. Enlarging holes by burning will not be permitted.

E. All materials shall be erected in compliance with OSHA 29 CFR, Part 1926, Subpart R, and in compliance with all other applicable OSHA and local safety regulations.

3.2 INSPECTION AND TESTING

A. When the quality control section indicates that special inspections are required, such inspections shall be performed for field fabrication and erection of structural and miscellaneous metals, and for all structural steel field connections. The erector shall provide access as needed to facilitate all inspections and shall provide timely notification during erection when inspection milestones are approaching.

3.3 STRUCTURAL AND MISCELLANEOUS STEEL

A. Except as otherwise specified or indicated on the drawings, all work shall conform to the applicable provisions of the AISC "Manual of Steel Construction - Allowable Stress Design", Parts 1, 2, 3, and 4, the AISC "Specification for Structural Steel Buildings", and the Structural Welding Code of the American Welding Society.

B. Unless otherwise noted, connections shall conform to the details indicated on the design drawings and the fabrication and erection drawings prepared by the steel and metal suppliers. Field welded connections shall not be substituted for field bolted connections indicated on the drawings.

C. Field bolted connections shall conform with the provisions for unfinished and high strength bolted connections. Unless specifically required otherwise, all bearing and slip critical connections shall be fully pre-tensioned.

D. Field welding shall conform with the welding provisions specified. All field welding shall be performed by welders qualified in accordance with American Welding Society for steel welding and American Society for Mechanical Engineers Section IX for stainless steel welding. Welding procedure specifications and qualification records and welder qualification records shall be submitted as needed. All welds shall be visually inspected in accordance with AWS procedures.

3.4 STRUCTURAL AND MISCELLANEOUS ALUMINUM

A. Unless otherwise noted, all work shall conform to applicable provisions of the Aluminum Association "Standard for Aluminum Structures".

B. Unless otherwise noted, connections shall conform to the details indicated on the design drawings and the fabrication and erection drawings prepared by the aluminum suppliers. Field welded connections shall not be substituted for bolted connections without prior approval of the Engineer.

C. Field welding of aluminum shall conform with the welding provisions specified. All field welding shall be performed by welders qualified in accordance with the American Welding Society. Welding procedure specifications and qualification records and welder qualification records shall be submitted as needed.

D. Field bolted connections of aluminum shall conform with the specified. Unless otherwise required, all bolted connections shall be fully pre-tensioned.

3.5 CHECKERED FLOOR PLATES

A. Checkered floor plates shall be secured to supporting structure or grating as indicated on the drawings. Plates shall lie flat with no warping or curling. Plate edges shall be neat and parallel. Connection devices shall not protrude above the plate surface.

3.6 LADDERS

A. Ladders and cages shall be installed as indicated on the drawings. Firm, secure anchorage shall be provided to the supporting structure.

3.7 STAIRS

A. Stairs shall be true to line and slope, shall be rigidly supported, and shall be braced and tightened to prevent movement. All treads shall be level and in true alignment and spacing. Handrails shall be in alignment and rigidly connected.

B. After installation, stairs shall be rigid and shall not sway noticeably or deflect under foot traffic. If necessary to prevent noticeable movement, additional supports or bracing shall be provided.

3.8 PAINTING

A. After erection, structural and miscellaneous metals shall be cleaned and painted in accordance with the protective coatings, Section 09 90 00 – Painting. Damaged primer and galvanized coatings shall be cleaned and touched up prior to finish painting. If metals are required to be finish painted before erection, damaged areas of coating shall be cleaned, re-primed, and repainted to match the original coating system.

END SECTION

SECTION 07 41 13

METAL ROOFING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Metal roofing system over roof sheathing.

B. Metal flashing and roof openings

1.2 RELATED WORK

A. Section 05 50 00 – Fabricated Metal

B. Section 09 90 00 – Painting

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures

B. Product Data: Manufacturer's product data and installation instructions.

C. Shop Drawings: Provide as follows:

1. Shop drawings shall show roof plans and elevations, indicating extent of work to be performed.

2. Include sections of roof, fascia, walls, siding and soffits, for each condition, detailing flashing and trim for different conditions, such as eaves, outside and inside corners, ridges, valleys, gutters, end wall terminations, closures and similar conditions, showing a full and complete installation.

3. Show securing details of panels and clips, spacing, type and number of fasteners, as recommended by manufacturer.

D. Samples: Submit selection samples as follows:

1. 2-foot (610 mm) long sample panel indicating metal, gauge, color, texture and finish.

E. Quality Assurance/Control Submittals: Submit the following:

1. Test Reports: Submit test reports demonstrating compliance with finish requirements.

2. Certificates: Submit manufacturer's certificate that products meet or exceed all specified requirements.

1.4 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents. Provide warranties as follows:

1. Warranty covering the metal substrate against rupture, perforation and structural failure due to normal atmospheric corrosion.

a. Substrate Warranty Period: 25 years beginning with date of substantial completion.

2. Warranty on paint finish against cracking, peeling, blistering, chalk and color change.

a. Finish Warranty Period: 30 years for Standard Colors.

PART 2 PRODUCTS

2.1 ROOF PANELS

A. Sheet Steel Stock: ASTM A653 Grade A; ASTM A792 zinc-aluminum coating on roof; galvanized to ASTM A653 G90.

1. Panels shall be uniformly dimensioned, roll formed to exact lengths to avoid trimming.

2. Panels shall be continuous from ridge to eaves with no end laps with no face penetration of panels, except as indicated and for securing panels to facilitate directional expansion/contraction.

B. Finish: Kynar 500 (Fluoroceram) coating standard three coat, thermo-cured, full strength 70 percent resins, or Engineer approved equivalent.

C. Standing seam roofing panels providing 12-inch coverage.

D. Joint Seal Gaskets: Manufacturer's standard type.

E. Fasteners: Manufacturer's standard type, galvanized to ASTM A153 1.25 oz/sq ft, finish to match adjacent surfaces when exterior exposed.

F. Sealant: Manufacturer's standard type, non-staining, elastomeric, skinning.

G. Roofing Felt: 30 lb

2.2 FLASHING AND TRIM:

A. Standard or special flashing/trim and such other material break formed in the same gauge, color and finish to match roofing panels.

B. Provide materials with protective strippable film to be removed upon installation.

C. Accessories such as clips, closures, fasteners, etc., shall be as recommended by manufacturer.

PART 3 EXECUTION

3.1 DELIVERY AND STORAGE

A. Comply with instructions and recommendations of the manufacturer.

3.2 EXAMINATION

A. Site Verification of Conditions:

1. Verify that site conditions are acceptable for installation of the metal roof and wall panel system.

a. Verify substrate is uniform, even and symmetrical by running a string test.

b. Inspect to ensure that all purlins or other substructure and framing members are flat so when the metal panels are applied, they will not appear wavy or distorted.

2. Do not proceed with installation of the metal roof and wall panel system until unacceptable conditions are corrected.

3.3 INSTALLATION

A. General: Comply with the following:

1. SMACNA Architectural Sheet Metal Manual.

2. NRCA Roofing and Waterproofing Manual and Handbook of Accepted Roofing Knowledge.

3. Manufacturer's Construction Details.

4. AISC Steel Construction Manual.

5. AISI Cold Formed Steel Design Manual.

B. Install metal panel system plumb, level and straight over a layer of 30 lb felt, (dry)] with a minimum 6-inch (152 mm) horizontal lap and 12-inch (305 mm) end lap.

C. Install standing seam equidistant and aligned for corners, hips, valleys, mullions and columns in accordance with architectural design parameters indicated on drawings.

D. Install panel system in accordance with approved shop drawings.

E. Make no face penetrations or perforations in metal panels by fasteners except as indicated or with specific approval by Engineer.

F. Install all panels continuous from ridge to eaves with no horizontal end laps.

G. End lap all flashing and trim at least 3 inches (76 mm).

H. Miter and solder all gutters and seal with a lining of ice and water shield membrane applied at the laps to provide watertight condition.

1. Apply sealant at all butt joints.

2. Counter-flash or paint to match all soldered areas.

I. Treat all valleys with a layer of ice and water shield spread out at least 24 inches (610 mm) each side from the center of the valley, on both sides, before applying valley flashing.

J. End lap at least 6 inches (152 mm) at joints.

K. Exercise care during installation to avoid damage or scratching of the panels.

1. Avoid walking on metal roof panels after installation is completed.

3.4 CLEANING

A. Peel off any strippable film on flashing components as they are installed.

B. Touch up all minor scratches and spots.

C. Remove and legally dispose of all debris resulting from work under this Section.

3.5 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

END SECTION

SECTION 08 11 00

METAL DOORS & FRAMES

PART 1 GENERAL

1.1 WORK INCLUDED

A. All metal door and frames and related items necessary required to complete the work as indicated in the Plans.

B. All labor, materials, equipment, and incidentals necessary and required for their completion.

1.2 RELATED WORK

A. Section 03 15 20 - Anchor bolts and Expansion Anchors

B. Section 09 90 00 - Painting

1.3 GOVERNING STANDARD

A. Except as modified or supplemented herein, all steel doors and frames shall conform to the requirements of ANSI/SDI 100.

1.4 NOMENCLATURE

A. The nomenclature used herein conforms to ANSI A123.1.

1.1 SUBMITTALS

A. Submit shop drawings of all items specified herein per the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop drawings shall indicate details of each frame type: location in the building for each item; conditions at openings with various wall thicknesses and materials; typical and special details of construction; methods of assembling section; location and installation requirements for hardware; size, shape and thickness of materials; joints and connections.

1.2 ACCEPTABLE PRODUCTS

A. Subject to the requirements specified herein, internally reinforced doors and accompanying frames shall be equivalent to the following:

1. The Ceco Corporation Medallion

2. Curries Manufacturing Company Series 747T

3. Pioneer Industries Series C

4. Republic Builders Products DS Series

1.3 SHOP FINISH

A. A primer shall be applied to all surfaces of ferrous metal furnished under this section. Metal surfaces shall be cleaned and given a phosphate or equivalent treatment to ensure maximum corrosion protection and paint adherence. A dip or spray coat of synthetic resin, rust-inhibitive, metallic oxide or zinc chromate primer shall be applied to all surfaces, then baked or oven-dried. Finished surfaces shall be smooth and free from irregularities.

B. All finishes shall be in accordance with Section 09 90 00

1.4 MEASUREMENTS

A. Measurements are given to define the size of the door and the Contractor shall verify all dimensions at the project before proceeding with its manufacture.

PART 2 PRODUCTS

2.1 MATERIALS

A. Materials used in the manufacture and installation of steel doors and frames shall be as follows:

1.	Door and Frames	ASTM A366 or A569, stretcher leveled, commercial quality sheet steel with smooth, clean surface.
2.	Internal Reinforcing	ASTM A366, cold-rolled steel.
3.	Fillers for Internally Reinforced Doors	Mineral wool or fiberglass.
4.	Urethane Core	Liquid urethane, expanded in place; self-bonding, self-hardening, and self-extinguishing.
5.	Anchoring Devices	Zinc plated where exposed; zinc plated or galvanized where concealed.
6.	Expansion Anchors	As specified in the anchor bolts and expansion anchors section.

2.2 FRAMES

Frames for doors shall be formed of steel to the sizes and shapes indicated. Metal for frames shall be not lighter than 16 gage.

A. The finished work shall be strong and rigid, neat in appearance, and free from defects. Molded members shall be fabricated straight and true with corner joints well formed, and with fastenings concealed where practicable.

B. Joints for frames shall be mitered or butted and continuously welded on the reverse side to produce rigid joints which are invisible on the face of the frame. Frame bottoms shall be held rigidly in position by spreader bars to maintain proper alignment during shipment and erection.

C. Frames shall be prepared at the factory for the specified hardware. Frames shall be mortised, reinforced, drilled, and tapped for mortised hardware, and shall be reinforced for surface-applied hardware. Cover boxes shall be provided in back of all hardware cutouts. Lock strikes shall be set out and adjusted to provide clearance for silencers.

D. Concealed metal reinforcements shall be provided for hardware with the following minimum thicknesses:

1. Hinge reinforcement 10 gage

2. Strike reinforcement 14 gage

3. Closer reinforcement 12 gage

4. Other reinforcement 14 gage

2.3 DOORS

A. Doors shall be flush hollow metal with urethane core and shall be as specified herein. Doors shall be prepared to receive the hardware specified in the finish hardware section.

B. Doors shall be rigid, neat in appearance, and free from defects. All welded joints on exposed surfaces shall be dressed smooth so that they are invisible after finishing.

C. Doors shall be 1-3/4 inches thick, full flush type, of the sizes and design indicated. Clearances for doors shall be 1/8 inch at jambs and heads and 3/4 inch at bottom unless otherwise indicated or specified.

D. Doors shall have 18 gage seamless outer sheets. Side edges of doors shall be flush and closed watertight. All seams shall be continuously welded and ground smooth. Doors shall be prepared at the factory for hardware as indicated on the Plans and as specified. Door edges shall be beveled or rounded.

E. Internally reinforced doors shall have fillers placed in the spaces between reinforcing members and shall be reinforced by 22 gage or heavier vertical steel stiffeners installed on 6 inch centers and welded to face sheets.

F. Out swinging exterior doors shall be finished flush at the top with all seams and joints closed watertight as specified for side edges.

G. Doors shall be mortised, reinforced, drilled, and tapped for mortised hardware. Reinforcing units shall be provided for locksets. Reinforcing plates shall be provided for mortised and surface-applied hardware in at least the following thicknesses:

1.	Hinge reinforcement	10 gage
2.	Surface-applied closers and hold open arms	12 gage
3.	Other reinforcement	14 gage

H. The location of hardware items shall be in accordance with DHI "Recommended Locations for Builders' Hardware for Standard Steel Doors and Frames."

PART 3 EXECUTION

3.1 WORKMANSHIP

A. General: Insofar as possible, execute fitting, constructing and fabricating at shop, ready for erection at building. Provide holes, connections and fastenings for and to work of other trades abutting, adjoining or intersecting specified work.

B. Hardware: Execute hardware fitting at shop. Provide slackage or mortises as required; form accurately to template so that hardware will fit neatly into depressions with member flush, unless otherwise required.

3.2 HOLLOW METAL FRAMES

A. General: Hollow metal frames shall be installed where indicated.

B. Wall Anchors: Equip frames on each side with four (4) anchors at door frames. Weld anchors to flange returns or to flanges near the back of the frame.

C. Knee Anchors: For frame bottoms extending to the floor, use 14 gage knee angle anchors 2" x 2", width of frame; spot welded to frame; provide two 3/8-inch diameter holes in horizontal leg.

D. Rubber Bumper: Drill frames for approved rubber bumpers on all strike jambs except at exterior doors.

3.3 HOLLOW METAL DOORS

A. General: Hollow metal doors shall be the type, design, sized as specified and installed on a vertical plane.

B. Clearance: provide doors with minimum clearance necessary for operation without binding.

3.4 PROTECTION

A. Protect doors and frames from damage during transportation. Damaged work will be rejected and shall be replaced with new work.

B. Protect frames from damage at jobsite. Store, at the site, under cover on wood blocking or on suitable floors. After installation, protect frames from damages during subsequent construction activities. Damaged work will be rejected and shall be replaced with new work at no cost to the Owner.

3.5 INSTALLATION

Install work in correct locations, in alignment, plumb, and in true planes. Make breaks, angles and corners square with walls. Set work that is to be built-in correctly; maintain until enclosed or built-in and, except for moving parts, fasten securely in place; make rigid. Do required blocking and wedging for frames and hardware.

END SECTION

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SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Overhead coiling doors with operating hardware.

B. Related Sections

1. Division 05 50 00 – Bolts, Washers, Anchors and Eyebolts

2. Section 09 90 00 – Painting

1.2 REFERENCES

A. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

1.3 SYSTEM DESCRIPTION

A. Electric motor operated units with manual override in case of power failure.

B. Surface mounted.

1.4 DESIGN REQUIREMENTS

A. Design door assembly to withstand wind/suction load of 20 psf, without undue deflection or damage to door or assembly components.

B. Insulation Value: R of 6.25 minimum.

1.5 SUBMITTALS

A. As specified in Section 01 30 00 – Submittal Procedures.

B. Shop Drawings: Indicate gages and finish of metals, methods of joining members, location and reinforcement for hardware and anchorage, jamb side and head clearances required, pertinent dimensions, and installation details.

C. Product Data: Provide general construction, component connections and details; include information on materials and finishes.

D. Samples: Submit two door slats, 12 inch in size illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

1.6 MAINTENANCE DATA

A. Maintenance Data: Indicate lubrication requirements and frequency, periodic adjustments required.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.8 COORDINATION

A. Coordinate the work with installation of support framing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide model IMB V5® Insulated Rolling Service Doors as manufactured by Alpine Overhead Doors, Inc., East Setauket, NY, or Engineer approved equivalent.

2.2 MATERIALS

A. Curtain:

1. Slats: Constructed of 5/8” thick interlocking, roll-formed Insulated Metal Backed (IMB) V5 slats. (Slat construction allows for dual coiling flexibility)

a. Slat/Back Cover Material:

1) Aluminum

2) Finish: Mill Finish Clear anodized

b. Insulation: Polystyrene [foamed-in-place Polyurethane]

1) Thickness: 5/8”

2) R-Value: 4.50

c. Gauge: (Per manufacturer’s standard)

1) Front slat: Minimum 0.050” thick aluminum.

2) Back cover: Minimum 0.040” thick aluminum.

2. Endlocks and Windlocks (as required):

a. Ductile cast iron, hot-dip galvanized endlocks riveted (solid rivets, minimum 3/16” thick) to each end of alternate slats to prevent lateral movement and to limit slat deflection and bending stress.

3. Bottom Bar:

a. Two roll formed aluminum angles, minimum 2”x2” x1/8”, which extend into guides, designed to reinforce curtain bottom.

1) Aluminum

2) Finish: Mill Finish Clear anodized

B. Guides

1. Guides shall be designed using structural angles with a minimum thickness of 3/16”, minimum 1¼” slotted connections, and removable bellmouth curtain stops to allow for curtain maintenance without removal of guides. Bellmouth stops shall be flush with guide groove. Guides shall be fastened with minimum 3/8” bolts at minimum 24” o.c.

a. Material:

1) Extruded Aluminum

2) Finish: Mill Finish Clear anodized

C. Door Support Brackets and Mounting Plates

1. Steel plate not less than 1/4” thick. Provide ball bearings at rotating support points. Bolt plates to wall mounting angles with minimum 1/2" fasteners. Plate supports counterbalance assembly and forms end enclosures.

a. Material:

1) ASTM A240 Stainless Steel 300 Series

2) Finish: Mill Finish #2B

b. Stop Lock bearing: To prevent door from free falling in the event hand chain fails/slips.

D. Counterbalance Assembly: Torsion

1. Counterbalance assembly: Steel pipe barrel of a size capable of carrying a curtain load with a maximum deflection of 0.03” per foot of door width. Heat-treated helical torsion springs encased in a steel pipe and designed to include an overload factor of 25% to ensure minimum effort to operate. Sealed and prelubricated high speed ball bearing at rotating support points. Torsion spring charge wheel for applying spring torque and for future adjustments.

a. Material:

1) ASTM A312 Stainless Steel 300 Series

2) Finish: Mill finish

b. Life Cycle: Design doors of standard construction for normal use of 10,000 cycles standard (up to 400,000 cycles).

E. Hood

1. 0.040” aluminum. Formed to fit the contour of the end brackets with reinforced top and bottom edges. Provide support bracing for doors wider than 20 feet at every 10 feet to prevent excessive sag. Fastened to end brackets.

2. Shape: Hexagon

3. Material:

a. Aluminum

b. Finish: Mill Finish Clear anodized

4. Fascia: Galvanized Aluminum, provided where areas behind door hood are open. Materials and finish same as hood.

F. Locking

1. Manual chain hoist: Provide padlockable chain keeper on guide

G. Weatherstripping

1. Bottom Bar: Vinyl astragal.

2. Guides: Snap-on vinyl.

3. Hood: Neoprene baffle.

2.3 OPERATION

A. Manual hand chain:

1. Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide.

2.4 MOUNTING

A. Interior face mounted on prepared opening.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify conditions are satisfactory for the installation of the work of this Section.

B. Verify that opening sizes, tolerances and conditions are acceptable.

C. If unsatisfactory conditions exist, do not begin installation until such conditions have been corrected. Beginning installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install door unit assembly with electric operators and controls in accordance with manufacturer's instructions. Coordinate installation with electric service.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Install perimeter trim and closures.

3.3 ERECTION TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum variations: Do not exceed manufacturer's standards.

3.4 MANUFACTURER'S FIELD SERVICE

A. Manufacturer to furnish maintenance and call-back service for the duration of Contractor's warranty period.

B. Perform service by manufacturer's trained employees during regular working hours. Provide emergency service when requested.

C. Service

1. Include examination of equipment, adjustments, supplies, lubrication and parts necessary to keep equipment in proper operation.

2. The cost of adjustments, parts, and repairs made necessary by abuse, misuse, and other cause beyond manufacturer's control will be paid by Department at manufacturer's standard hourly rate.

3. Department will pay for emergency service, except where attributable to faulty materials or equipment.

3.5 ADJUSTING

A. Test each assembly for proper operation.

B. Adjust and lubricate door, hardware and operating assemblies for smooth, quiet operation, free from binding.

3.6 CLEANING

A. Clean door and components.

B. Exposed surfaces shall be free from scratches, dents, tool marks, stains, discoloration, other defects and damage.

C. Remove labels and visible markings.

END SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Field painting including surface preparation, surface protection, clean up, and/or other appurtenant work.

B. All labor, materials, tools and equipment, and incidentals necessary and required for their completion.

C. All pipe, fittings, equipment, and structures are to be field coated except for those specific exceptions contained in this specification or identified on the drawings. The painting schedule included at the end of this specification summarizes the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to extend the limits of coating systems, or to clarify or show details for application of the coating systems.

D. All coatings for potable water service shall be ANSI-NSF Standard 61 certified.

1.2 SUBMITTALS

A. Submittals shall be in accordance with the Standard General Conditions and the Supplementary Conditions.

1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Performance criteria as required by the Engineer to determine quality.

c. Manufacturer’s installation instructions and environmental parameters.

d. Material Safety Data Sheets.

e. Color samples.

1.3 AIR QUALITY REGULATORY COMPLIANCE

A. All paint shall conform to the applicable air quality regulations at the point of application. Any paint material which cannot be guaranteed by the manufacturer to comply, whether specified by product designation or not, shall not be used.

B. The volatile organic compound (VOC) of coatings materials limits set forth in Rule 460.1 of the San Joaquin Valley Unified Air Pollution Control District shall apply to this project. The manufacturers' products listed in paragraphs 09900-3.01 and 3.02

have been selected on the basis of their apparent compliance with Rule 460.1; however, it shall remain the Contractor's responsibility to ensure that all coatings materials furnished are in compliance with all regulatory agencies.

C. The product listed may meet the VOC requirement in the unthinned (as shipped) condition, but may exceed the VOC requirement if thinned to the manufacturer's allowable recommendations. In this situation, the product is not to be thinned beyond the limit indicated in Rule 460.1, and if the product cannot be suitably thinned for the intended application method or temperature requirements, it will be necessary to use another manufacturer's product subject to acceptance by the Engineer.

D. It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products which will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop or field primed surfaces, or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.

E. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be fumeproof. Paint shall be lead-free and mercury-free.

1.4 QUALITY OF WORK

A. All finishes shall be applied by skilled workmen in accordance with the best practices and standards of the painting trade. Brushes, rollers, all equipment, and the techniques used in applying finishes shall be of sufficient quality to assure the specified results. Work not conforming to this Specification shall be corrected by touching up or refinishing as directed by the Engineer.

B. It is the purpose and intent of this Specification to cover the complete paint finishing of all exterior and interior surfaces as scheduled or specified and all surfaces which normally require a paint finish for corrosion resistance, weather protection, finished appearance or utility. Finished surfaces shall be of the type of finish, color sheen film thickness and quality specified.

1.5 DELIVERY AND STORAGE

A. Painting materials shall be delivered to site in manufacturer's original containers with labels intact and seals unbroken. Painting materials and equipment shall be stored and protected against freezing and mixed in rooms assigned for that purpose. No chemicals, unauthorized thinners, or other materials, not included in the paint formulation shall be added to the paint for any purpose. All necessary precautions shall be taken to prevent fire. Rags or waste soiled with paint shall be removed from premises at end of each day's work, or shall be stored in covered metal containers.

1.6 EQUIVALENT PRODUCTS

A. Whenever a coating is specified using the name of a proprietary product or the name of a particular manufacturer or vendor, the specified coating shall be understood as establishing the type and quality of coating desired.

B. Other manufacturers' products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the coatings proposed are equivalent to those named. Proposed coatings shall be submitted for review in accordance with the Section 01 33 00 - Submittals.

C. Requests for review of equivalency will not be accepted from anyone except the Contractor, and such requests will not be considered until after the contract has been awarded.

D. Specific products for various applications shall be as specified in Part 2. In addition to the products named in Part 2, equivalent products of the following manufacturers will also be acceptable:

Ameron
Carboline
Devoe
PPG (Pittsburgh)
Sherwin Williams Co.
Sinclair
Tnemec
Valspar

E. Contractor shall provide verification that equivalent products are acceptable for the desired application.

1.7 REFERENCE STANDARDS

A. SSPC – Society of Protective Coatings, Pittsburgh, PA

B. ASTM – American Society For Testing And Materials, West Conshohocken, PA

PART 2 PRODUCTS

2.1 GENERAL

A. All paint shall be the product of a recognized manufacturer exclusively engaged in the manufacture of painting material. All paints for wood and metal surfaces shall be well-ground and shall not skin, liver, curdle, or body excessively in the containers.

B. The paint shall not show laps or unevenness of color or texture. When applied to vertical surfaces, it shall not sag.

C. All exposed surfaces, including sides and edges, shall be painted. Hangers, brackets, fastenings and other miscellaneous items shall be painted with the same system as the adjacent material. Paint systems shall be in addition to shop primers.

D. Paint shall be stored inside and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the paint formation shall be added to the paint for any purpose.

E. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Any paint system shall be the product of a single manufacturer.

F. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be lead-free, mercury-free, and fumeproof. Where paint materials are referenced to Federal or military specifications, the reference shall define general type and quality required but is not intended to limit acceptable materials to an exact formulation.

G. For each paint, the Contractor shall follow the paint manufacturer's specific application instructions. Upon the Engineer's request, the Contractor shall furnish the following application instructions.

1. Surface preparation recommendations.

2. Type of primer to be used.

3. Maximum dry and wet mil thickness per coat.

4. Minimum and maximum curing times between coats.

5. Thinner to be used with each paint.

6. Ventilation requirements.

7. Atmospheric conditions during which the paint shall not be applied.

8. Allowable methods of application.

9. Maximum allowable moisture content and minimum age of plaster, concrete and wood surfaces at time of paint application.

10. Curing time before submergence in water.

H. The minimum number of coats and minimum total dry mil thickness of the system for each surface shall be as specified in the paint schedule.

2.2 PAINTING SCHEDULE

A. A schedule is appended to this section listing the surface preparation, primer, finish and dry mil thickness to be used on each surface to be coated.

2.3 PRIMERS AND PRETREATMENT

A. P-1 Epoxy Primer - Minimum dry thickness 4 mils. Devoe "Bar Rust 235H", Sherwin Williams “Macropoxy 646 FC Epoxy B58-600”, or Tnemec 69-1211 "Hi-Build Expoxoline."

B. P-2 Rust Inhibitive, non-submerged - Minimum dry thickness 3 mils. Devoe "Devran 203 Waterborne Epoxy Primer", Sherwin Williams “Macropoxy 646 FC Epoxy B58-600” or Tnemec 135 "Chem Build."

C. P-3 Rust inhibitive, submerged - Minimum dry thickness 4.0 mils. Devoe "Bar Rust 235H", Sherwin Williams “Macropoxy 646 FC Epoxy B58-600” or Tnemec 136 "Chem Build.”

D. P-4 Primer for Wood – Maximum of 400 sq. ft/gal. Devoe 2010-1200 "Ultra- Hide Durus Exterior Acrylic Primecoat", Sherwin Williams “A-100 Wood Primer B42W41” or Tnemec 151 “Elaso-Grip.”

E. P-5 Wallboard Primer – Maximum of 400 sq. ft/gal. Devoe1060-1200 "Ultra- Hide Latex Primer- Sealer", Sherwin Williams “Preprite 200 Interior Latex Primer B28W200”, or Tnemec 51-792 "PVA Sealer."

F. P-6 High Build Acrylic – Maximum of 100 sq. ft/gal., Tnemec 180 WB Tneme-Crete, Sherwin Williams “Heavy Duty Block Filler B42W46”.

2.4 INTERMEDIATE AND FINISH PAINTS

A. F-1 Epoxy Resin - Minimum dry thickness 5 mils. Devoe "Bar Rust 235H", Sherwin Williams “Macropoxy 646 FC Epoxy B58-600”, or Tnemec 69 "Hi-Build" epoxy.

B. F-2 Gloss Acrylic Emulsion - Minimum dry thickness 2.0 mils Devoe “ Devflex 4208 Waterbone Acrylic Enamel”, Sherwin Williams “Shercryl Hi Performance Acrylic Gloss B66-300”, or Tnemec 1028.

C. F-3 Semi-gloss Acrylic Emulsion - Minimum dry thickness 2.5 mils Devoe “Devvflex 4216 HP Waterborne”, Sherwin Williams “Shercryl Hi Performance Acrylic Semi-Gloss B66-350”, or Tnemec 1029 “Tuf Cryl”.

D. F-4 High Build Epoxy (Substitute for Coal Tar) - Minimum dry thickness 6 mils. Devoe “Devtar 5A HS”, Sherwin Williams “Targuard Coal Tar Epoxy B69B60”, or Tnemec “V69F Black"

E. F-5 Polyurethane O - Minimum dry thickness 2 mils. Devoe “Devthane 379H Aliphatic Urethane Gloss Enamel”, Sherwin Williams “Hi Solids Polyurethane CA B65j-300”, or Tnemec 1075 "Endurasheild."

F. F-6 Acrylic Epoxy – Minimum dry film thickness 4 mils. Tnemec 113 Tneme-Tufcoat, Sherwin Williams " Waterbased Tile Clad Epoxy B73-100".

G. F-7 High Build Acrylic – Maximum of 100 sq. ft./gal.Tnemec 180 WB Tneme-Crete, Sherwin Williams "Heavy Duty Block Filler B42W46".

2.5 FUSION BONDED EPOXY LINING AND COATING

A. Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Provide Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red", or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (Minimum):	Barcol 17 (ASTM D2583) Rockwell 50 ("M" Scale)
Abrasion Resistance (Minimum)	1,000 cycles: 0.05 gram removed 5,000 cycles: 0.115 gram removed ASTM D1044, Tabor CS 17 wheel 1,000 gram weight
Adhesion (Minimum)	3,000 psi (Elcometer)
Tensile Strength	7,300 psi (ASTM D2370)

2.6 ALUMINUM SURFACES

A. All aluminum in contact with steel or concrete: Sherwin Williams "Macropoxy 646 FC Epoxy B58-600 series or approved equivalent..

2.7 SHOP COATINGS

A. Shop coatings shall be applied as indicated in the individual equipment and component specifications.

B. Electric motors, speed reducers, starters, and other self contained or enclosed components shall be shop primed or finished with a high grade, oil resistant enamel suitable for top coating in the field with an alkyd enamel.

C. All shop coatings shall be compatible with the pain system specified in the Painting Schedule contained at the end of this specification.

2.8 SURFACES NOT TO BE PAINTED

A. Except as otherwise required or directed, the following surfaces are to be left unpainted:

1. Exposed surfaces of aluminum (aluminum in contact with concrete is to be coated).

2. Polished or finished stainless steel. Unfinished stainless steel shall be painted.

3. Nickel or chromium.

4. Galvanized surfaces, except piping, conduit, electrical conduit, pipe supports, fasteners, hangers, bracing, brackets, and accessories.

5. Rubber and plastics, including fiberglass reinforced plastics.

6. Precast concrete.

2.9 SYSTEM IDENTIFICATION

A. Above Grade Piping: Provide markers on piping which is either exposed or concealed in accessible spaces. For piping systems, other than drain and vent lines, indicate the fluid conveyed or its abbreviation, either by preprinted marker or stenciled marking, and include arrows to show the direction of flow. Comply with ANSI A13.1 for colors. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through floor, walls or ceilings or otherwise pass into inaccessible spaces, and at 50' maximum intervals along exposed portion of lines. Marking of short branches and repetitive branches for equipment connections is not required.

B. Equipment: All equipment shall be identified with a plastic laminated, engraved nameplate which bears the unit mark number as indicated on the drawings (e.g. AC-4). Provide 1/2" high lettering, white on black background. Nameplates shall be permanently secured to the unit.

C. Valves: Provide valve tags on all valves of each piping system, excluding check valves, valves within equipment, faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Provide brass tags or plastic laminate tags. Prepare and submit a tagged valve schedule, listing each valve by tag number, location and piping service. Mount in glazed frame where directed.

2.10 COLORS

A. All colors and shades of colors shall be as specifically indicated in the specifications or plans, or, where not specifically indicated, selected from the manufacturer’s standard color samples by the Owner.

B. Electrical conduit shall be painted to match adjacent ceiling or wall surfaces as directed by the Engineer.

PART 3 EXECUTION

3.1 PRELIMINARY EXAMINIATION

A. Notify the Engineer in writing of any uncorrected defects in surfaces to be painted. Do not proceed with the finishing of surfaces in question until any discrepancies are corrected. No work on any surface shall be started, unless the surface has been inspected and approved for painting by the Engineer.

3.2 SURFACE PREPARATION

A. The Contractor shall prepare the surfaces to be coated as specified under the paint schedule. Any surfaces to be coated which are not listed under the paint schedule shall be prepared in accordance with the manufacturer's instructions for the material to be applied.

B. All grease, oil, dirt, and other contaminants which may affect the bond between the coating and the surface shall be removed by a cleaning agent which will leave the surface clean and dry.

C. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces.

D. Surfaces shall be free of cracks, pits, projections, or other imperfections which would prevent the formation of smooth, unbroken paint film, except for concrete block construction where a rough surface is an inherent characteristic.

E. When applying touch-up paint, or repairing previously painted surfaces, the surfaces to be painted shall be cleaned and sanded or wire brushed in such a manner that the edges of adjacent paint are feathered or otherwise smoothed so that they will not be noticeable when painted. All paint made brittle or otherwise damaged by heat or welding shall be completely removed.

F. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to painting if there is no evidence of dirt, corrosion, or foreign material.

G. All galvanized surfaces shall have a metal conditioner applied prior to the first prime coat.

H. All surfaces to be finished shall be clean and dry before any materials are applied. Use a moisture meter to determine moisture content as follows. The moisture content shall be less than 18% for wood; 8% for concrete or plaster.

1. Metal Surfaces - Where noted, the surface preparation for steel and other metals refer to the specifications for surface preparation by the latest revision of the Steel Structures Painting Council. All metal work shall be cleaned of grease, oil and dirt by solvent cleaning (SSPC-SP1). Do not use hydrocarbon based solvents for cleaning prior to use of acrylic materials.

a. Method SP-2: Surface shall be wire brushed where required to remove loose rust and dirt, etc. (SSPC-SP2)

b. Method SP-3: Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders. (SSPC-SP3)

c. Method SP-6: Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues. (SSPC-SP6)

d. Method SP-10: Sandblast to near white condition. This method shall remove all rust and scale, but streaks and shadows in the metal will be acceptable. (SSPC-SP10)

2. Wood Surfaces

a. Method W-1: All unprimed millwork delivered to the jobsite shall be given the specified first coat on all surfaces immediately upon arrival. Give all unprimed woodwork the specified first coat as soon as possible following installation. Prime any wood surface that is to be in contact with concrete, or a caulking material, with the specified first coat material before installation. Unless specified otherwise, all casings and trim, and all woodwork shall be free of oil, dirt, loose fibers, etc., sealed with a sanding sealer recommended by the coating manufacturer, and sanded smooth and dusted thoroughly before application of the priming coat. Give all knots, pitch pockets and sappy areas a preliminary coat of Dutch Boy Knot Sealer, or approved equivalent, prior to application of the prime coat.

3. Galvanized Surfaces

a. Method G-1: All galvanized surfaces shall be prepared for painting in strict conformity with the instructions of the manufacturer. All galvanized shall be cleaned per SSPC-SP7.

4. PVC Pipe

a. Method V-1: All wax and oil shall be removed from PVC plastic surfaces by wiping with a solvent of the type used for the specified primer.

3.3 PAINT APPLICATION

A. Apply all finishes evenly, free from sags, runs, crawls, brush marks, skips or other defects. Apply products at the proper consistency and do not thin or otherwise alter them except in accordance with the manufacturer's printed directions. All coats shall be applied in such manner as to produce an even film of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen.

B. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air, or the bridging over of crevices and corners. Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Nozzles shall be of proper size. Floors, roofs, and other adjacent areas and installations shall be satisfactorily protected by drop cloths or other precautionary measures. All over-spray shall be removed by approved methods or the affected surface repainted. Care shall be exercised to avoid lapping of paint on hardware of other unscheduled surfaces.

C. Each coat of material shall be thoroughly dry before the application of a succeeding coat. In no case shall paint be applied at a rate of coverage per gallon which is greater than the maximum rate recommended by the manufacturer. Paint films showing sags, checks, blisters, teardrops, or fat edges will not be accepted. Paint containing any of these defects shall be entirely removed and the surface repainted.

D. Sandpaper enamels and varnishes lightly between coats and dust thoroughly before the application of a succeeding coat.

E. If the finish coat is to be colored, the prime coat and the intermediate coat shall be tinted to have a slight variation in color from each other and from the finish coat.

3.4 PRIMING

A. Edges, corners, crevices, welds, and bolts shall be given a brush coat of primer before the specified spot or touch-up painting of metal surfaces. Special attention shall be given to filling all crevices with paint.

B. Abraded and otherwise damaged portions of shop applied paint shall be repainted. Welded seams and other uncoated surfaces, heads and nuts of field installed bolts, and surfaces where paint has been damaged by heat, shall be given a coat of the specified primer. This patch, spot, or touch-up painting shall be completed, and shall be dry and hard, before additional paint is applied.

3.5 LATEX PAINT

A. Latex paint shall be applied by brushing or rolling; spraying is not permitted. Latex paint shall not be thinned excessively.

3.6 MIXING AND THINNING

A. Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.

B. Unless otherwise authorized, all paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below that represented by the recommended coverage rate.

3.7 FILM THICKNESS FOR FERROUS METALS

A. It is intended that the dry film thickness and the continuity of painted ferrous metal surfaces be subject to continual field check by the Engineer. Dry film thickness shall be measured by the Contractor, using an approved Thickness Gauge, at locations selected by Engineer. Testing equipment provided shall be provided by Contractor and kept on site.

B. Measurement of Dry Coating Thickness shall conform with paint application Standard SSPC-PA2

C. Thickness and Holiday Checking - Thickness of coatings and paint shall be checked with a non-destructive, magnetic type thickness gauge.

D. Holiday Checking of all interior coated surfaces shall be tested with an approved holiday detection device. Non-destructive holiday detectors shall not exceed 100 volts nor shall destructive holiday detectors exceed the voltage recommended by the manufacturer of the coating system. For thicknesses between 10 and 20 mils (0.25mm and 0.50mm) a non-sudsing type wetting agent such as Kodak Photo-Flo, shall be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and re-tested. No pinholes or other irregularities will be permitted in the final coating. Holiday detection devices shall be operated in the presence of the Engineer.

E. Continuity shall be tested by a low voltage-wet sponge per RPO 188. Contractor shall perform continuity tests as required by the Engineer on surfaces that will be submerged.

3.8 ATMOSPHERIC CONDITIONS

A. Apply all material to dry and properly prepared surfaces when weather conditions are favorable for painting. No materials shall be applied when the temperature of the materials is below 50 degrees F, or when the temperature of the air, surface to be painted or substrate, is below (or likely to fall below) 50 degrees F. Final ruling on the favorability of weather conditions shall be in accordance with the recommendations of the manufacturer and/or the Engineer.

B. No coating or paint shall be applied to wet or damp surfaces, in rain, snow, fog, or mist, when the steel temperature or surrounding air temperature is less than 5 degrees above the dew point, nor in conditions not recommended by the manufacturer

3.9 REPAIRING DAMAGED PAINT ON EQUIPMENT

A. Painted surfaces on equipment, which have become damaged prior to acceptance by the Owner, shall be repainted with the same or equivalent paint used in the original application.

3.10 PROTECTION OF SURFACES

A. Throughout the work the Contractor shall use drop cloths, masking tapes, and other suitable measures to protect all surfaces from accidental spraying, splattering, or spilling of paint. Contractor shall be liable for and shall correct and repair any damaged condition resulting from its operations or from the operations of all those who are responsible to the Contractor during the time its work is in progress and until the work is accepted. In case bituminous paints are spilled or dropped on any material except metals, the spots shall, after surface cleaning, be spot painted with aluminum paint prior to applying the specified paint. Any exposed concrete or masonry not specified to be painted which is damaged by paint shall be either removed and rebuilt or, where so authorized by the Owner, painted with two coats of masonry paint.

3.11 CLEANUP

A. All cloths and cotton waste which might constitute a fire hazard shall be placed in metal containers or destroyed at the end of each work day. Upon completion of the work all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer.

3.12 PAINTING SCHEDULE

		FINISH			
SYSTEM	SURFACE	SURF. PREP.	PRIME COAT	2ND COAT	3RD COAT
1.	New ferrous metal in submerged or damp environment including all submerged mechanical components.	SP-10	P-1	F-1	F-1
2.	All exterior exposed new structural and miscellaneous steel. All exterior exposed surfaces of new piping, pumps, motors, electrical equipment and other unsubmerged mechanical and structural items.	SP-2 or 3	P-2	F-2	F-2
3.	All surfaces of new structural and miscellaneous steel pipe, pumps, motors and electrical equipment panels exposed inside building.	SP-6	P-2	F-3	F-3
4.	All interior exposed new galvanized metalwork including electrical conduit inside buildings, including fittings, boxes, supports and accessories.	G-1	P-3	F-3	F-3
5.	All exterior exposed new galvanized metalwork including roof flashings ad other architectural items.	G-1	P-3	F-2	F-2
6.	Exposed new PVC piping	V-1	F-5	F-5	

7.	All new buried valves and flanged joints and other buried miscellaneous ferrous piping and metal surfaces (excluding cast iron pipe). All exterior surfaces of new cast iron and steel piping exposed in manholes, wet wells and similar locations, including valves, fittings, flanges, bolts, supports, and accessories. Miscellaneous new castings, including manhole rings and covers and manhole steps. (One coat, if not foundry dipped.)	SP-10	F-4	F-4
8.	Interior wood	P-4	F-2	F-2
9.	Exterior wood	P-4	F-3	F-3
10.	Interior dry wall	P-5	F-6	
11.	Exterior concrete block	P-6	F-7	
12.	Concrete	P-6	F-7	

3.13 When conflicting painting specifications or requirements are encountered in the contract documents, the more restrictive specifications or requirements shall be required.

END SECTION

SECTION 09 97 20

CHEMICAL-RESISTANT COATINGS FOR CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

This section includes materials and installation of chemical-resistant coatings for concrete in chemical containment areas.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 90 00- Painting and Coating

B. Section 03 30 10 – Cast in Place Concrete

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit manufactures cut sheets for application coats to give specified dry thickness and finish coats.

C. Submit manufactures surface preparation guidelines, application instructions, recommended application equipment, curing requirements, and temperature limitations.

D. Submit maintenance instructions including procedures for patching of damaged coatings.

E. Submit certification from the coating product manufacturer documenting that the specific coating systems being applied are compatible with and intended for the chemicals being stored.

F. Submit documentation that the installer is certified by the product manufacturer for application of the specific coating system being applied.

PART 2 MATERIALS

2.1 SERVICE CONDITIONS

A. Containment Area “A” – Acids

1. 93% Sulfuric Acid

B. Containment Area “B” – Salts

1. 39% Ferric Chloride

C. Containment Area “C” – Bases/Oxidizers

1. 25 – 50% Sodium Hydroxide

2. 12.5% Sodium Hypochlorite

2.2 COATING SYSTEMS

A. Coating shall be suitable for incidental spills, drips, and splashes and intermittent submergence (e.g. chemical tank failure).

B. Specific products for the various containment areas shall be as specified below. In addition to the products named below, equivalent products from the following manufacturers will also be acceptable: Madison Chemical Industries, ITW Futura, or Carboline

C. Dudick Coatings

Containment Area “A” – 100% solids, high build novolac epoxy coating system (Protecto Flex 100XT). Basecoat and topcoat shall be 15 – 20 mils minimum each. Color: grey.

Containment Area “B” – Flake filled or carbon filled, high build thermosetting vinyl ester coating system (Protecto Flex 800 or 805). Basecoat and topcoat shall be 15 – 20 mils minimum each. Color: grey or black.

Containment Area “C” – Flake filled, high build thermosetting vinyl ester coating system (Protecto Flex 805). Basecoat and topcoat shall be 15 – 20 mils minimum each. Color: grey.

D. Coatings applied to areas containing polymers shall be seeded with sand or aluminum oxide to provide an anti-skid surface.

E. Abrasives for Surface Preparation of Concrete

Abrasives used for preparation of concrete surfaces shall be 16 to 30 or 16 to 40 mesh silica sand.

PART 3 EXECUTION

3.1 GENERAL

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying coating systems similar in material, design, and extent to those indicated for this project, whose work has resulted in applications with a record of successful in-service performance, and who is certified by the coatings manufacturer.

B. Coating System

1. Materials including primer, intermediate, and finish coats shall be produced by the same manufacture. Thinners, cleaners, driers, and other additives shall be as recommended by the coating manufacture.

2. Deliver coatings to the jobsite in the original, unopened containers.

3. Material should be stored between 70ºF and 32ºF. DO NOT FREEZE or expose

C. Protection of Surfaces Not To Be Coated

Remove, mask or otherwise protect hardware, and other surfaces not intended to be coated.

D. Weather Conditions

1. The following restrictions on weather conditions are in addition to those of the coating manufacturer. The more restrictive requirements shall apply.

2. Do not coat in the rain, wind, snow, mist and fog or when surface temperatures are less than 3ºF above the dew point.

3. Do not apply coatings when the relative humidity is above 85 % or the temperature is above 90ºF.

4. Do not coat when temperature of concrete to be painted is above 120ºF.

5. Do not apply coatings if air or surface temperature is below 60ºF or expected to drop below 60ºF in 24 hours.

E. Surface Preparation

1. Surface preparation coating until concrete has cured at least 30 days. Finish concrete surface per Section 03 33 01. Do not use curing compound on surface that are to be coated.

2. Concrete surfaces to be coated shall be of even color, gray or gray-white. The surface shall be free of pits, pockets holes of sharp changes in elevation. Scrubbing surface with a stiff-bristled fiber brush shall not produce dusting of dislodging of cement of sand. If holes are present fill holes with suitable material. Dry abrasive blast to remove any laitance on the concrete surface (SSPC SP 13 or NACE 6). Abrasive blast clean with sand or grit (G40 or coarser), do not use steel shot or non-angular media.

3. Clean concrete surface with detergent (trisodium phosphate per ASTM D4258 or D4261). Then abrasive blast surfaces (brush-off blast) per ASTM D4259. 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. Rinse thoroughly to achieve a surface

pH of 10.0 to 13.0. Take at least two Ph readings for each 300 square feet or portion of.

4. Test for surface strength per ASTM D4541, as modified by ACI 503R. Provide one test for every 300 square feet. The minimum surface tension shall be 300 psi or as per coating manufacture, which ever value is greater.

5. Prior to coating new concrete walls and ceilings, 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 to remain in place for 24 hours. After 24 hours examine both the underside of the plastic sheet and the concrete surface beneath it. There shall be no indication of moisture on either surface. 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 on test sheet for every 300 square feet or portion thereof of concrete surface to be coated. For walls, provide on test sheet for each 10 feet of vertical rise in all elevations starting within 12 inches of the floor or base slab.

6. Prior to coating floors, determine the presence of moisture by means of the calcium chloride test per ASTM F1869. The MVER shall not exceed 3 pounds per 1,000 square feet per 24 hours. If test results exceed this value, provide additional curing time and rest until test results meet this value.

7. Do not apply coatings to concrete when the concrete is outgassing or when the concrete surface temperature is rising.

F. Abrasive Blast Cleaning

1. Use dry abrasive blast cleaning material. When field blast cleaning with hand held nozzles, do not recycle or reuse blast particles. Abrasive blast sand or grit (G40 or coarser), do not use steel shot or non-angular media.

2. After blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping or vacuuming to remove residue from blasting. Primer coat shall be applied within an eight (8) hour period after cleaning. Reclean prior to application of primer or touch-up coating any blast-cleaned surface not coated within the eight hour period.

3. Work area to be kept in a clean condition, blasting particles shall be left to accumulate to constitute a nuisance or hazard.

4. Keep newly coated surfaces free from dust, dirt, or other contaminants until dry.

G. Coating Application

1. Roll or agitate individual components thoroughly before use to disperse pigments and assure homogeneity. Do not thin. As required by manufactures suggestions.

2. Products shall be applied as directed by the manufacture's recommendations.

3. If more than forty-eight (48) hours have elapsed since the application of the prime, sand the surface lightly but thoroughly with 120 to 150 grit sandpaper and remove dust with a damp cloth.

4. The finished coating should be generally smooth, glossy and free of blisters, pinholes, craters, fisheyes, uncured areas, discoloration and thin areas.

5. Repairs-remove any damaged or unsound coating. Sand one inch past the damaged area and remove all dust and grit before applying the repair coatings, one or more touch up coats as directed by the engineer.

H. Material Preparation

1. Prepare material as per manufacture's recommendations.

I. Application Equipment

1. Use equipment suggested in the manufactures specifications.

2. Provide proof of training on manufactures specified equipment.

J. Dry Film Thickness Testing

1. Check each coat for the correct dry film thickness. No not measure within eight (8) hours after application of the coating.

2. 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 SP0188-2006 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.

3. Make five separate spot measurements spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. 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-swuare-foot area shall be less than 80%, or more than 120% of the specified thickness.

3.2 HOLIDAY (CONTINUITY) FIELD TESTING

A. The Owner's representative will inspect each coat and approval shall be granted to proceed before the application of the next coat is applied in accordance with ASTM D4787. Deficient areas shall be repaired as specified in these specifications.

B. The test pressure to be used shall be not less than one and one-half (1½) times the proposed maximum working pressure, but not less than three (3) psi (20 kPa), irrespective of design pressure.

END SECTION

SECTION 09 97 61

FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100 percent solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves, flexible pipe couplings, and steel pipe.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 14 – Fabricated Steel Specials

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.

B. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.

C. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 MATERIALS

2.1 PIPING AND EQUIPMENT SURFACES

A. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.

B. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

2.2 SHOP-APPLIED EPOXY LINING AND COATING

A. Lining and coating shall be a 100 percent solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Valspar "Pipeclad 1500 Red," or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

2.3 FIELD-APPLIED EPOXY COATING FOR PATCHING

A. Use a minimum 80 percent solids liquid epoxy resin, such as Scotchkote 306 or 323.

2.4 PAINTING AND COATING OF GROOVED-END AND FLEXIBLE PIPE COUPLINGS

A. Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 EXECUTION

3.1 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING - GENERAL

A. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.

B. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

C. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5 degree Fahrenheit above the dew point temperature during blast cleaning and inspection.

D. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

E. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

3.2 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO PIPE-ADDITIONAL REQUIREMENTS

A. Apply lining and coating per AWWA C213 except as modified herein.

B. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

3.3 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO JOINT AREAS OF DUCTILE -IRON AND CAST-IRON FITTINGS - ADDITIONAL REQUIREMENTS

A. Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

3.4 QUALITY OF LINING AND COATING APPLICATIONS

A. The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.5 FACTORY TESTING OF COATING - GENERAL

A. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.

B. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. 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.

3.6 FACTORY INSPECTION OF LINING AND COATING OF PIPE-ADDITIONAL REQUIREMENTS

A. Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

3.7 SHIPPING, STORAGE, AND HANDLING

A. When loading piping, fittings, couplings, or other coated items for shipment to the project site, use spacers and other protective devices to separate pipes or other coated items to prevent damaging the coated surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the coated surfaces after separation. Use padded chains or ribbon binders to secure the loaded pipe or other coated items and minimize damage.

B. Do not load or unload pipe, fittings, couplings, or other coated items by inserting forklift tines or lifting chains inside the pipe or item. Use nonmetallic slings, padded chains, or padded forklift tines to lift pipe or other coated items.

C. Cover piping or other coated items 100 percent with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

D. Provide stulls, braces, and supports for piping during shipping and storage such that out-of-roundness or deflection does not exceed 0.5 percent of the pipe diameter.

E. Handle piping and other coated items with care during the unloading, installation, and erection operations to minimize damage. Do not place or store pipe or other coated items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place pipe or other coated items above the ground upon platforms, skids, or other supports.

F. Store piping or other coated items at the site on pallets to prevent direct contact with ground or floor. Cover pipe or coated items during storage with protective coverings or tarpaulins to prevent deposition of rainwater, salt air, dirt, dust, and other contaminants.

G. Do not allow piping or other coated items to contact metal, concrete, or other surfaces during storage, handling, or installation and erection at the site that could damage or scratch the coating.

3.8 FIELD REPAIRS

A. Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80 percent solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply an epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove

the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END SECTION

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SECTION 11 00 00

GENERAL EQUIPMENT STIPULATIONS

PART 1 GENERAL

1.1 SCOPE

A. All equipment furnished and installed under this Contract shall conform to the general stipulations set forth in this section except as otherwise specified in other sections.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

1.3 COORDINATION

A. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.4 MANUFACTURER'S EXPERIENCE

A. Unless specifically named in the Specifications, a manufacturer furnishing equipment of the type and size specified shall have been in successful operation for not less than the past five years.

1.5 WORKMANSHIP AND MATERIALS

A. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

C. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

1.6 LUBRICATION

A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during start up or shutdown and shall not waste lubricants.

B. Lubricants, of the type recommended by the equipment manufacturer, shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

C. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

PART 2 PRODUCTS

2.1 DRIVE UNITS

A. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24-hour continuous service.

1. Gear motors. Unless otherwise specified, the use of gear motors will not be acceptable.

2. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

3. Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class II. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall bear an AGMA nameplate.

4. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100º F above the ambient air temperature in the vicinity of the unit and shall not exceed 200º.

5. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic re-greasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent over-greasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

6. Gear reducers which require the removal of parts or periodic disassembly of the unit for cleaning and manual re-greasing of bearings will not be acceptable.

7. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

   a. Variable Speed Drives. Each mechanical variable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor. A spare belt shall be provided with each variable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

   b. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.6 at maximum speed based on the nameplate horsepower of the drive motor.

2.2 SAFETY GUARDS

A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage or heavier galvanized or aluminum-clad sheet steel or 1/2 inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

2.3 ANCHOR BOLTS

A. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with the anchor bolts and expansion anchors section and, unless otherwise specified, shall have a minimum diameter of 3/4 inch.

B. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on base plates shall be long enough to permit 1-1/2 inches of grout beneath the base plate and to provide adequate anchorage into structural concrete.

2.4 EQUIPMENT BASES

A. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least six inches high. Cast iron or welded steel base plates shall be provided for pumps, compressors, and other equipment. Each unit and its drive

assembly shall be supported on a single base plate of neat design. Base plates shall have pads for anchoring all components and adequate grout holes. Base plates for pumps shall have a means for collecting leakage and a threaded drain connection. Base plates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the grout section.

2.5 SPECIAL TOOLS AND ACCESSORIES

A. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2.6 SHOP PAINTING

A. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade, oil-resistant enamel suitable for top coating in the field with an alkyd enamel. Coatings shall be suitable for the environment where the equipment is installed.

B. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

1. All shop primers shall be compatible with the paint system specified in Section 09 90 00, Painting and Coating, for the particular item.

C. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust preventive compound, such as Houghton "Rust Veto“, Rust-Oleum "R-9" or Engineer approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION FOR SHIPMENT

A. All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

C. Grease and lubricating oil shall be applied to all bearings and similar items.

D. Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

3.2 STORAGE

A. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

B. Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60º F. Equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

C. Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

3.3 INSTALLATION AND OPERATION

A. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results. When so specified, or when employees of Contractor or his Subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.

B. Qualified field representatives shall be provided by the equipment manufacturers as required to perform all manufacturer's field services called for in the Specifications. Manufacturer's field representatives shall observe, instruct, guide, and direct Contractor's erection or installation procedures, or perform an installation check, as required. The field representative shall revisit the site as often as necessary to attain installation satisfactory to Engineer.

C. All equipment installed under this Contract shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

D. Acceptance of Work in connection with the installation of equipment furnished by others will be subject to approval of the field representative. Contractor shall be responsible for planning, supervising, and executing the installation of Work, and the approval or acceptance of Engineer or the field representative will not relieve Contractor of responsibility for defective Work.

3.4 OBSERVATION OF PERFORMANCE TESTS

A. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests.

3.5 WARRANTY

A. A written manufacturer's warranty shall be provided for equipment supplied under this contract. The warranty shall be for a minimum of one (1) year or as specified in accordance with other Sections of the contract documents, after the date the equipment is accepted for use by the Owner by filing of the notice of completion, unless otherwise agreed in writing by Owner. The warranty shall cover all defects or failures of materials, design, or workmanship that occur as the result of normal operation and service.

END SECTION

SECTION 13 07 00

SEISMIC REQUIREMENTS FOR CONTRACTOR FURNISHED AND/OR INSTALLED ITEMS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Comply with the CBC Chapter 16, Section 1613 - Earthquake Loads plus clarifications and additions specified in this Section.

B. Provide vertical support, lateral bracing, anchorage and adequate space for movement of the following items:

1. Equipment. Examples include tanks (excluding self-supporting tanks), vessels, electrical and mechanical machinery.

2. Non-Structural Components. Examples include suspended ceilings, raised floors, partitions, storage racks and architectural features.

3. Systems. Examples include conduit, piping, cable trays, raceways and ducts.

4. Non-building structures. Examples include elevated tanks, horizontally support tanks, flat-bottom tanks, telecommunication towers and signs.

C. Take full responsibility for the equipment anchorage design, which may be performed by the manufacturer or supplier.

D. Furnish and install all integral parts of the anchoring system as well as any anchorages or restraints that are independent of the equipment, but required by the manufacturer or supplier.

E. Install anchorages with direct connections to structural elements shown on the drawings.

F. Notify the Engineer if, in the opinion of the manufacturer, supplier or the Contractor, the anchorage conditions are so special that the available structural elements will not resist the anchorage forces. The Engineer will then provide instructions for procedures to be followed.

G. Submit certification for all equipment specified in Divisions 02 through 46 inclusive. State that the equipment or component anchorage, and where required, the equipment itself, complies with the requirements of this Section. Include in the Certification the following:

1. Description, sketch and seismic load capacity of the anchorage.

2. Where required by the technical specifications or is listed as a deferred submittal, equipment anchorage calculations by an engineer registered in the State in which the project is being built.

3. Where required by Sections 1.2 M.1 or 2 below, a statement that the equipment assembly is designed to resist seismic forces required by this Section.

H. Coordinate the layout and detailing of each system so that adequate space is provided between different items for seismic motions. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.

I. The Engineer's Review of items within a Specification Division cannot be completed until all items have been coordinated and submitted for review.

1.2 SPECIFIC REQUIREMENTS

A. The project is located at 37.530 latitude and -120.881 longitude.

B. The Risk Categories are as follows:

1. All water storage facilities and pump structures needed for fire suppression and public utility facilities required for emergency backup for other essential facilities shall be considered essential facilities – Risk Category IV.

2. All schools, assembly buildings, power-generating facilities, water and wastewater treatment facilities and other public utility facilities not in Risk Category IV shall be considered Risk Category III.

3. Agricultural facilities and minor storage facilities shall be considered Risk Category I.

4. All other buildings and structures shall be considered Risk Category II.

5. Apply the Importance Factors appropriate for the Risk Category above.

C. The Seismic Design Category is D.

D. The mapped spectral acceleration for short periods, S_S=0.676

E. The mapped spectral acceleration for 1-second period, S_1=0.267

F. The site coefficient F_a=1.259

G. The site coefficient F_v=2.066

H. The maximum considered earthquake acceleration for short periods, S_{MS}=0.851

I. The maximum considered earthquake acceleration for 1-second period, S_{M1}=0.552

J. The design spectral acceleration for short periods, S_{DS}=0.568

K. The design spectral acceleration for 1-second period, S_{D1}=0.368.

L. The project area is Site Class D.

M. Equipment, Non-Structural Components and Systems Design:

1. Seismic design of equipment, non-structural components and systems shall be in conformance with ASCE 7 Chapter 13.

2. Provide support details for piping, conduit, duct or other systems to resist minimum loadings specified above, if not shown on the Drawings. Support systems required for fluid carrying piping greater than 5 inches diameter are shown on the Drawings.

N. Non-Building Structures Design

1. Seismic design of non-building structures shall be in conformance with ASCE 7 Chapter 15.

O. Comply with more detailed requirements in Division 2 through 46 inclusive and the requirements of the relevant nationally recognized Society or Association:

1. For ductwork, mechanical piping, process piping and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:

a. Seismically brace all piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.

b. Seismically brace all ductwork regardless of size or location. Provide transverse braces at all changes in direction and at each end of run. Space braces not over 20 feet apart. Provide longitudinal braces at 40-foot centers.

2. For fire protection systems, follow NFPA 13 modified as in paragraph 1.b above. Ensure that no seismic interaction occurs with items of other systems.

1.3 SPECIFIC REQUIREMENTS FOR SPECIAL HYDRAULIC STRUCTURES

A. To allow for water sloshing, design rigid items such as piping or equipment supports for twice the lateral force, computed as if the item were above water.

END SECTION

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SECTION 13 34 19

METAL BUILDING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Design and Fabrication

1. Designed, pre-engineered and shop fabricated structural steel building frame including concrete foundation and ADA comliant restroom for both open and closed structures.

2. Metal wall and sloped roof system including soffits, gutters and downspouts.

3. Exterior doors, windows, skylights, overhead doors, louvers.

4. Flashings and insulation.

B. Erection of the metal building on concrete foundations including anchor bolts and all building accessories specified and indicated on the Plans.

C. Field painting, and other items on building construction not specifically covered herein and covered in other sections shall be provided in the construction of the prefabricated metal building.

D. All labor, materials, equipment and incidentals necessary and required for the completion of the building.

1.2 RELATED WORK

A. Section 03 30 10 – Concrete Site Work

B. Section 05 50 00 – Metal Fabrications

C. Section 09 90 00 – Painting and Coating

D. Section 08 33 23 – Overhead Coiling Doors

E. Division 26 – Electrical

1.3 REFERENCES

A. AAMA 101 – Specification for Aluminum Prime Windows and Sliding Glass Doors.

B. AAMA 603.8 – Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.

C. AISC – Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

D. AISC – Code of Standard Practice for Steel Bridges and Buildings.

E. AISI – Specification for the Design of Cold-Formed Steel Structural Members.

F. ASTM A36 – Structural Steel.

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

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

I. ASTM A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

J. ASTM A325 – Structural Bolts, Heat Treated, 120/105 ksi Minimum Tensile Strength.

K. ASTM A490 – Heat-Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength.

L. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

M. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

N. ASTM A529 – Structural Steel with 42 ksi (290 MPa) Minimum Yield Point (2 inch (13mm) Maximum Thickness).

O. ASTM A570 – Steel, Sheet and Strip, Carbon, Hot Rolled, Structural Quality.

P. ASTM A572 – High Strength Low Alloy Columbium-Vanadium Steel of Structural Quality.

Q. ASTM A792 – Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot-Dip Process, General Requirements.

R. ASTM C665 – Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

S. ASTM F593 – Stainless Steel Bolts, Hex Cap Screws, and Studs.

T. AWS A2.4 – Standard Welding Symbols.

U. AWS D1.1 – Structural Welding Code - Steel.

V. CCR – California Code of Regulations.

W. SSPC – Steel Structures Painting Council.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittals.

B. Submit structural drawings and calculations, signed and sealed by a structural engineer licensed in the State of California.

1. Submit five copies of complete structural design calculations. Submit with shop drawings.

2. Include vertical loads, lateral seismic loads, and wind loads.

3. Calculations shall be complete and shall include roof decks, wall panels, structural members, equipment supports, framing around openings, braces, connections, lateral bracing of equipment, bracing of interior and exterior walls, suspended ceilings, and suspended equipment.

4. When structural calculations are electronically prepared, submit diagrammatic models of each element, clearly cross-referenced to calculations.

C. Shop Drawings

1. Indicate assembly dimensions, locations of structural members, connections, attachments, openings, cambers, loads.

2. Indicate wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage, method of installation.

3. Indicate framing anchor bolt settings, sizes, and locations from datum, and foundation loads.

4. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.

5. Indicate openings, attachments, components, primers, finishes, and other information required for fabrication and erection.

D. Product Data: Provide data on profiles, component dimensions, fasteners, and manufacturer's specifications.

E. Certificates of welders performing structural welding.

F. Certificates that all bolts supplied and installed meet the requirements of these specifications.

G. Manufacturer's certificate that products meet or exceed specified requirements.

H. Submit location and schedule of off-site fabrication.

I. Manufacturer's Installation Instructions: Indicate requirements for assembly sequence, field bolting and welding, and painting and cleanup.

1.5 SYSTEM DESCRIPTION

A. Clear span rigid frame type and modular rigid frame type supported with intermediate columns as indicated.

B. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, intermediate columns, end wall columns, and wind bracing.

C. Secondary Framing: Purlins, girts, eave struts, flange bracing, sill supports, clips, and other items detailed.

D. Wall and Roof System: Preformed metal panels of indicated profile, with sub-girt framing/anchorage assembly, sag rods, insulation, and accessory components.

E. Roof Slope: One inch in 12 inches, unless otherwise indicated.

1.6 DESIGN REQUIREMENTS

A. Design building structure and components in accordance with requirements of CCR Title 24, Part 2. State Chapters apply. Alternate methods of analysis are not acceptable.

B. Conform to AISC and AISI Specifications.

C. Assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 60º F.

D. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

E. Metal building system shall be provided in accordance with the following schedule:

Name of Building	**Maintenance Shed**
Length – ft., in.	62’
Width – ft., in.	40’
Eave Height ft., in.	As shown
Roof Slope H:V	As shown
Rain Leaders	Yes
No. of HM Doors (Exterior)	2
Dimensions W x H ft.	3’ x 7’
No. of Overhead Doors	1
Dimensions W x H ft.	12’x 10’
Exterior Windows	No
Louvers	As required
Roof Vents	As required

1.7 STRUCTURAL DESIGN - VERTICAL LOADS

A. Design for in-place loads generated by the materials used, equipment supported on roofs or walls, equipment suspended from roofs or walls, suspended finishes, and other items indicated to be supported.

B. Design for minimum 10 psf dead load for mechanical piping and ceiling loads in addition to the metal building dead load. Add 5 psf collateral load for mechanical piping in areas where no ceiling is specified.

C. Where operating equipment is located on, or suspended from the structure, the design weight of the equipment shall be increased 20 percent for impact.

D. In addition to the loads specified above, design Structure to support the following minimum live loads, unless greater loads are indicated:

1. Uniform live load on roofs and canopies: 20 pounds per sq ft.

E. Allowable Deflections Under Dead and Live Loads

1. Structural Members: L/240 of the clear span.

2. Roof: L/240 of the center to center span.

1.8 STRUCTURAL DESIGN - LATERAL LOADS

A. Design structure to resist wind load of 110 mph, exposure C using Method 1 per CCR Title 24, California Building Code, State Chapters. CBC Chapter 16A (Standard Occupancy Structure Building Category 4) I = 1.5.

1. Design and detail skin, roof decks, walls, and roof supporting members for pressure and suction acting perpendicular to the surface.

2. Deflection of skin, roof decks, walls, and roof supporting members for pressure and suction acting perpendicular to the surface shall not exceed L/240 of the center to center span.

3. Limit drift due to wind forces, computed at the eave, to H/200 times the eave height.

B. Design structure to resist seismic forces. Determine V per CBC Chapter 16A (Building Category 3):

1.

Z = 0.40 (PGA = 0.26 g)
Soil Profile = Type S_D.
Na = 1.0 source factor
Nv = 1.0 source factor
I = 1.00
R = 4.5 for moment-resisting frames.
R = 4.2 for braced frames, provided that all members and connections in braced frames be designed for 3(Rw/8) times the design seismic force.
R = 2.2 cantilevered column building

2. Limit drift due to seismic forces, computed at the eave, to H/200.

3. Design structure to carry equipment loads including, but not limited to, mechanical equipment, plumbing, electrical, suspended ceilings, interior and exterior partitions, masonry walls, and storage contents of mezzanines.

1.9 STRUCTURAL DESIGN - LATERAL BRACING SYSTEM

A. Bracing and connections shall be capable of transferring loads from structure to foundations in a direct manner. Eccentricities shall be avoided, and shall be accounted for where they occur. Wall bracing shall clear all openings and not penetrate rated walls.

B. There shall be a complete and continuous "collector" and "chord" system capable of delivering the code specified lateral forces to the bracing systems. Collector and chord members shall be designed to resist axial tension and compression forces in combination with any other loads delivered simultaneously to these members.

C. Provide adequate tie-downs for overturning forces to the foundations. Coordinate column base details with details indicated on structural Drawings.

D. Longitudinal Vertical (Wall) Bracing

1. Lateral Force Resisting System: Concentric diagonal braced frames on member center lines or moment resisting frames.

2. Braces: Steel angle sections.

3. Washers: Cast iron or similar brittle material shall not be used for washers.

4. Where moment frames are used in conjunction with braced frames, moment frames must have compatible (equivalent) stiffness to the braced frames, and the "R" value for the most stringent system shall be used for computing loads on the entire structure.

E. Roof Bracing: Design braces for three times the code-specified forces, including the importance factor "I", if tension only braces are used, and where the slenderness ratio exceeds 120.

F. Metal building Foundation: Foundation design presented on drawings is generic in nature and intended only to provide general scope of foundation required. Contractor shall submit engineering calculations and drawings for foundation construction sealed by an engineer having a current California registration as a Civil or Structural Engineer. Such calculations and drawings shall show modifications to the foundations as required for the specific roofing and framing system proposed. Foundation system shall be designed using CBC soil pressures or geotechnical recommendations. Foundations and anchorages shall accommodate building reactions from gravity loads, live loads, seismic forces and wind loads.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years experience.

1. Certified under the AISC Quality Certification Program.

2. ICBO Approved.

B. Design Work under direct supervision of a Professional Civil or Structural Engineer experienced in design of this work and licensed in the State of California.

1.11 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this Section, under provisions of Division 1.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Provide factory wrapping, packaging, and other means necessary to prevent damage or deterioration during shipping, handling, and storage.

B. Maintain protective coverings in place and in good repair until removal is necessary for the work.

C. Store products inside enclosed storage facilities or closed building, supported above grade or on slabs-on-grade.

D. Maintain storage spaces and products in dry conditions and within temperature and humidity conditions recommended by manufacturer.

1.13 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication and installation.

1.14 SEQUENCING AND SCHEDULING

A. Coordinate the work of this section with other Sections whose work affects or is affected by the work of this Section.

B. Ensure proper sequencing and fitting of construction.

1.15 WARRANTY

A. Provide ten-year warranty.

B. Warranty

1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading.

2. Include coverage for weather tightness of building enclosure elements after installation.

3. Include coverage for insulation damaged by water intrusion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - BUILDING SYSTEM

A. Armco

B. Butler Builders

C. Star Building Systems

D. Varco Pruden

2.2 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A36, A529, or A572, Grade 50.

B. Structural Tubing: ASTM A500, Grade B.

C. Plate or Bar Stock: ASTM A529.

D. Anchor Bolts: ASTM A307, unprimed. Use stainless steel Type 316, ASTM F593 anchor bolts for unenclosed buildings.

E. Structural Bolts, Nuts, and Washers: ASTM A325 or A490.

F. Welding Materials: AWS D1.1; type required for materials being welded.

G. Primer: SSPC 15, Type 1, Red Oxide.

H. Grout: Non-shrink type, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2400 psi in two days and 7000 psi in 28 days.

2.3 MATERIALS - WALL AND ROOF SYSTEM

A. Sheet Steel Stock: ASTM A653 Grade A; ASTM A792 zinc-aluminum coating on roof; galvanized to ASTM A653 G90 designation elsewhere.

B. Insulation: ASTM C665, roll glass fiber type; faced with reinforced white vinyl vapor barrier where exposed; foil faced where concealed within wall cavities; perm rating 0.02 maximum; UL flame spread classification of 25 or less R-19 minimum thermal rating at roof, R-11 minimum at walls; 3 to 6 inches thick.

C. Joint Seal Gaskets: Manufacturer's standard type.

D. Fasteners: Manufacturer's standard type, galvanized to ASTM A153 1.25 oz/sq ft, finish to match adjacent surfaces when exterior exposed.

E. Bituminous Paint: Asphaltic type.

F. Sealant: Manufacturer's standard type, non-staining, elastomeric, skinning.

2.4 OVERHEAD DOORS

A. Overhead Door Frame: Formed steel sections braced to building frame.

2.5 HOLLOW METAL DOORS AND FRAMES

A. Hollow metal doors and frames are specified in Section 08 11 00.

2.6 FABRICATION - GENERAL

A. Form exposed work true to line and level, with accurate angles and surfaces, and straight, sharp edges.

B. Ease exposed edges unless otherwise indicated.

C. Form bent metal corners to smallest radius possible with out causing grain separation or other damage to work.

D. Form joints exposed to weather to exclude water.

E. Make permanent connections in ferrous metal surfaces using welds wherever possible; do not use bolts or screws where they can be avoided. Conceal fastenings where practical.

2.7 FABRICATION - SHOP ASSEMBLY

A. Preassemble items in the shop to greatest extent possible to minimize field splicing and assembly.

B. Disassemble units only as necessary for shipping and handling limitations.

C. Clearly mark units for reassembly and installation coordination.

2.8 FABRICATION - FRAMING

A. Fabricate structural steel members in accordance with AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

B. Fabricate members in accordance with AISC Specification for plate, bar, tube, or rolled structural shapes.

C. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete. Do not galvanize anchor bolts embedded in concrete.

D. Provide framing for openings.

2.9 FABRICATION - WALL AND ROOF SYSTEMS

A. Siding

1. Panel Configuration: Building manufacturer's standard, meeting specified requirements; minimum 24 gage thick; 36 inch net coverage width, 1-1/8 inch deep minimum; sculptured for rigidity.

2. Side Seams: Overlapping and concealed.

B. Roofing

1. Panel Configuration: Provide specified load carrying capabilities and deflection limitations; minimum 16 inches wide; minimum 24 gage.

2. Seams

a. Standing seams with factory applied non-hardening sealant.

b. Seams shall be continuously locked or crimped together by mechanical means during erection.

c. Panels with lap type longitudinal side joints and exposed fasteners are not acceptable.

3. Provide resilient gaskets as necessary for complete weather seal.

4. Structural Fastening System

   a. Panels shall be fastened to the purlins or secondary support members with a concealed clip or backing device of steel having a protective metallic coating.

   b. Through penetration of the roof surface by exposed fasteners shall occur only at terminal locations of roof panels.

   c. System shall allow the roof covering to move independently of differential thermal movement of the structural framing system.

5. Except at the concealed fastener, there shall be no thermal contact of the roof panels with the supporting purlins.

6. Where roof panels are to be used as structural diaphragms to resist wind or seismic forces, roof decks must have an ICBO approval and be installed in conformance with ICBO requirements. Shear values shall not exceed ICBO approved values.

7. Roof panels shall support walkways where indicated. Provide complete assembly and attach to structure.

C. Girts

1. Manufacturer's standard rolled formed structural shape meeting specified requirements.

2. Provide minimum one sag rod between spans.

D. Purlins

1. Rolled formed structural shape.

2. Design Capacity: Calculated in accordance with AISI Specification of the Design of Cold Formed Steel Structural Members.

3. Configuration, Thickness, Spacing: Manufacturer's standard.

4. Depth: Eight inches.

5. Bracing System: Conform with requirements of Metal Building Manufacturers Association.

E. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners with 0.07-inch thick sheet.

F. Expansion Joints: Same material and finish as adjacent material where exposed, 0.07-inch thick, manufacturer's standard brake formed type, of profile to suit system.

G. Flashings, Closure Pieces, Facia, Infills, Caps, and Trim: Same material and finish as adjacent material, profile to suit system. Provide at rake, corners, and eaves; at framed openings and wherever necessary to provide weather tightness and a finished appearance.

H. EPDM Rubber Boots: Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from EPDM rubber. Rubber boot material shall be approved by the metal building manufacturer, as compatible with the system. Boots shall have base rings fabricated of minimum 0.07 inch thick aluminum conforming to the contours of the roof panel, to form a weather tight seal.

I. Fasteners: To maintain load requirements, and weathertight installation, same finish as cladding, non-corrosive type.

1. Siding

a. Ten Feet or Less Above Adjacent Grade: Tamper proof metal fasteners.

b. More Than Ten Feet Above Grade: Manufacturer's standard screws or bolts.

2. Roofing

a. Stainless steel screws, bolts, or rivets with weatherseal washers, or carbon steel shank fasteners with vinyl or stainless steel capped heads.

J. Roof Openings

1. Openings Larger Than Eight Inches Round or Square: Framed with a welded base fabricated from minimum 0.07 inch thick aluminum.

2. Support base with roof purlins and header framing.

3. Base shall project minimum 12 inches above the roof weather surface; the configuration of the base flanges shall match the roof panel.

4. Fasten base flange to provide complete support and weathertightness.

K. Roof Curbs: Minimum 12-inch height, top of curb level; conform to NRCA standards.

L. Ventilators and Ridge Vents: Metal building manufacturer's standard; finish to match building.

M. Wall Louvers: Metal building manufacturer's standard type and finish; minimum 12 gage galvanized steel; self-framing, self-flashing, with integral head gutter; insect or bird screens as indicated with steel mesh screen and frame.

2.10 FABRICATION - GUTTERS AND DOWNSPOUTS

A. Fabricate of same material and finish as roofing metal; minimum 26 gage unless otherwise indicated.

B. Form gutters and downspouts to profile and size indicated to collect and remove water. Fabricate with connection pieces.

C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.

D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.11 FINISHES

A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.

B. Roof Panels: ASTM A792; zinc-aluminum coating over steel substrate; Galvalume.

C. Wall Panels: Factory applied thermoset siliconized polyester finish coating system; color selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify conditions are satisfactory to receive the work of this Section.

C. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

D. Do not begin installation until unsatisfactory conditions have been corrected. Beginning installation means acceptance of existing conditions.

3.2 PROTECTION

A. Protect adjacent, existing, and newly placed construction as necessary to prevent damage during installation of the work of this Section.

B. Do not remove wrappings or protective coatings on prefinished components until the component is ready for installation.

C. Provide bitumastic paint, minimum 15 mils thick, between dissimilar materials to prevent corrosion due to electrolytic action.

3.3 ERECTION - FRAMING

A. Erect framing in accordance with AISC Specification.

B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.

C. Set column base plates with non-shrink grout to full plate bearing.

D. Field cutting, altering, or burning of openings or framing will not be permitted.

E. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized including portions of anchor bolt assemblies not embedded in concrete.

3.4 ERECTION - WALL AND ROOFING SYSTEMS

A. Install in accordance with manufacturer's instructions.

B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.

C. Fasten cladding system to structural supports, aligned level and plumb.

D. Locate end laps over supports. End laps minimum 2 inches. Place sidelaps over bearing.

E. Provide expansion joints where indicated.

F. Use exposed fasteners.

G. Provide insulation where indicated.

1. Place roof insulation over roof purlins. Allow insulation to attain full thickness between purlins.

2. Place insulation with vapor barrier to building interior.

3. Fold and staple membrane joints in accordance with manufacturer's instructions.

4. Provide manufacturer's standard netting or other accepted method to hold roof insulation in place.

H. Install sealant and gaskets to prevent weather penetration.

I. System: Free of rattles, noise due to thermal movement and wind whistles.

3.5 ERECTION - GUTTER AND DOWNSPOUT

A. Rigidly support and secure components. Joint lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

B. Apply bituminous paint on surfaces in contact with cementitious materials.

C. Provide positive slope in gutters to downspouts.

D. Install splash blocks.

3.6 INSTALLATION - ACCESSORIES

A. Install door frames, doors, overhead doors, and windows and glass, in accordance with manufacturer's instructions.

B. Seal wall and roof accessories watertight and weather tight with sealant.

3.7 TOLERANCES

A. Framing Members: 1/4 inch from level; 1/4 inch from plumb.

B. Siding and Roofing: 1/8 inch from true position.

3.8 MANUFACTURER'S FIELD SERVICE

A. Manufacturer's representative shall provide inspection services during the work of this Section.

B. Manufacturer's representative shall certify to Department that work has been installed in accordance with manufacturer's instructions.

3.9 ADJUSTING

A. Clean shop-primed ferrous metals of dirt and rust; touch-up shop applied primer using same material.

B. Touch-up minor damage on painted finishes.

1. Use touch-up paint of type recommended by finish manufacturer.

2. Minimize overlap to undamaged areas.

3. Match color, gloss, and appearance of surrounding area.

C. Remove damaged panels and component parts of the work. Replace with undamaged components of the type specified.

3.10 CLEANING

A. Remove coverings from the face of siding and refinish surfaces as necessary to prevent rusting and discoloration of finished surfaces.

B. Clean exposed surfaces of prefinished work promptly after completion of installation. Comply with coating manufacturer's instructions.

END SECTION

SECTION 22 40 10

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work required under this section consists of related items necessary and required to complete the work. The Contractor shall provide all items, and operations, including all labor, materials, equipment, and incidentals necessary for completion of work.

B. Section Includes

1. Floor Drains
2. Cleanouts
3. Backflow Preventers
4. Trap Primer

1.2 RELATED WORK

1.3 REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

B. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

C. ANSI A112.21.1 - Floor Drains.

D. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures

B. The information shall include but shall not be limited to the following:

1. Complete assembly, foundations, and installation drawings, together with detailed specifications and data covering materials used and accessories forming part of the equipment furnished.
2. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
3. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

4. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

5. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, trap primers.

6. Operation and Maintenance Data: Indicate frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

A. Manufacturers:

1. J.R. Smith

2. Josam

3. Zurn

4. Wade

2.2 CLEANOUTS

A. Manufacturers:

1. Zurn, Model 1400

2. Smith, Model 4020

3. Josam, Model 58010

B. Cleanout to Grade: Round cast nickel bronze access frame and non-skid cover.

C. Floor Cleanout: Galvanized cast iron, two piece body with double drainage flange, weep holes, and scoriated cover in areas with quarry tile floor square with depressed cover to accept floor finish.

2.3 BACKFLOW PREVENTERS

A. Manufacturers

1. Febco

2. Watts

3. Wilkins

B. Reduced Pressure (RPP) Backflow Preventers: ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two independently-operating, spring loaded check valves; diaphragm-type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks,

1. RPP Backflow preventer shall be Febco Model 825Y, or Engineer-approved equivalent.

2.4 TRAP PRIMERS

A. Manufacturers:

1. Precision Plumbing Products

2. Zurn

3. Watts

B. Provide a wall access panel to allow access to all trap primer valves.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

3.3 INSTALLATION - BACKFLOW PREVENTERS

A. Install backflow and back-siphoning prevention devices to protect the water supply as required by CCR Title 24, Part 5, California Plumbing Code.

B. Vacuum Breakers:

1. Mount at least 6 inches above the highest point of discharge.

2. Locate after the last valve; there shall be no downstream valves.

C. Pressure Vacuum Breakers:

1. Mount at least 12 inches above the highest point of discharge.

2. Pressure vacuum breakers may have downstream valves, but must not be subjected to backpressure.

D. Reduced-Pressure-Principle Backflow Prevention Devices:

1. Mount at least 12 inches above grade.

3.4 FIELD QUALITY CONTROL - TESTING AND INSPECTION

A. Testing of backflow protection and anti-siphon devices prior to activation of the water supply line shall be performed by a Certified Tester.

B. Devices shall conform to the requirements of applicable codes, or the following requirements, whichever are the more stringent.

C. Atmospheric Vacuum Breaker:

1. Perform visual inspection.

a. Verify there are no downstream valves.

b. Verify there are no leaks or mineral stains indicating leaks from the vent.

D. Pressure Vacuum Breaker:

1. Test opening pressure differential of the air inlet valve.

2. Air inlet valve shall open when the pressure in the body is no less than 1.0 psi above the atmospheric pressure; the air opening valve shall be fully open when the water drains from the body.

3. Test check valve for tightness in the direction of flow. The check valve shall be drip-tight in the normal direction of flow when the inlet pressure is 1.0 psi and the outlet pressure is atmospheric.

E. Reduced-Pressure-Principle Devices:

1. Test operation of the pressure differential relief valve.

2. The zone between the two check valves shall be at least 2.0 psi less than the supply pressure.

3. Test Check Valve Number 2 for tightness against reverse flow. Valve shall be tight against reverse flow under all pressure differentials.

4. Determine static pressure drop across Check Valve Number 1. Pressure drop shall be at least 3.0 psi greater than the pressure differential between the line pressure and the pressure in the zone required to open the pressure differential relief valve.

3.5 ADJUSTING

A. Repair or replace items not conforming to specified requirements at no additional cost to Owner.

END SECTION

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SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under Division 26.

B. Related work under this section

1. Labor and materials required to furnish and install the electrical systems in a complete and operational fashion.
2. Carpentry, masonry, steel and concrete materials and labor required for construction of proper stands, bases and supports for electrical materials and equipment.
3. Cutting and patching of holes required by installation including flashing and counter-flashing of roof and exterior wall penetrations.
4. Excavating, pumping and backfilling required for installation.
5. Repair of damage to the premises resulting from construction activities under this Section to Owner's satisfaction.
6. Removal of work debris from construction activities to Owner's satisfaction.
7. Testing and cleaning of equipment installed.

C. Work not under this section

1. Furnishing of motors, pumps, fans, compressors, water heaters, thermostats and motor starters included under Divisions 23 and 40, or as noted otherwise.
2. Finish painting of exposed metal surfaces included under Division 9, or as otherwise noted.
3. Electrical Contractor shall provide connections to mechanical equipment where voltage exceeds 50 V and all necessary raceways for low voltage controls.

D. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations

a. Title 8 –Industrial Relations; Section 1 –Department of Industrial Relations
    1) Chapter 3.2 -California Occupational Safety and Health Regulations (CAL/OSHA)
    2) Chapter 4 –Section of Industrial Safety
        a) Subchapter 4 -Construction Safety Orders (CSO)
        b) Subchapter 5 -Electrical Safety Orders (ESO)
b. Title 24 –California Building Standards
    1) Part 1 -Building Standards Administrative Code
    2) Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
    3) Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
    4) Part 4 -California Mechanical Code (MEC); IAPMO Uniform Mechanical Code (UMC) with California amendments
    5) Part 5 -California Plumbing Code; IAPMO Uniform Plumbing Code (UPC) with California amendments
    6) Part 6 -California Energy Code
    7) Part 7 -California Elevator Safety Construction Code
    8) Part 9 -California Fire Code; International Fire Code (IFC) with California amendments
    9) Part 12 -California Reference Standards Code

2. CPUC –California Public Utilities Commission
    a. GO-95; Rules for Overhead Electric Line Construction
    b. GO-128; Rules for Construction of Underground Electric Supply and Communication Systems
3. IEEE –Institute of Electrical and Electronic Engineers
    a. C2; National Electrical Safety Code (NESC)
4. NECA –National Electrical Contractors Association
    a. 1; Standard Practices for Good Workmanship in Electrical Contracting
    b. 4090; Manual of Labor Units
5. All applicable local municipal codes and ordinances.
6. Applicable rules and regulations of local utility companies.

1.03 SUBMITTALS

A. Product Data
    1. Refer to Section 01 33 00 “Submittals.”
B. Closeout Submittal

1. Furnish three complete sets of maintenance and operating instructions bound in a binder and indexed to Owner. Start compiling data upon approval of materials and equipment. Final inspection will not be made until Engineer approves binders. Refer also to Division 1 for additional requirements.
2. Provide one of each manufacturer proprietary tool required for proper equipment operation and maintenance provided under this Division. All tools shall be delivered to the Owner at project completion.
3. Provide two keys to Owner for each lock furnished under Division 26.
4. As-Built Drawings

1.04 SUBSTITUTIONS

1. Refer to Division 0.

1.05 CHANGE ORDER PROPOSALS

A. Refer to Division 0.

B. All change order proposals and requests, both additive and deductive, shall be accompanied by a detailed materials and labor breakdown for each specific task and/or item.

1.06 QUALITY ASSURANCE

A. References to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to bid submittal. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

B. Work and materials shall be in full accordance with the latest rules and regulations of applicable state of local laws or regulations and standards of following:

1. National Fire Protection Association (NFPA)
2. California Electrical Code (CEC)
3. California Occupational Safety Health Act (Cal-OSHA)
4. California State Fire Marshall (CSFM)
5. California Code of Regulations (CCR)
6. Electrical Safety Orders, CAC Title 8 (ESO)
7. California Public Utilities Commissions, General Order 95 (GO-95)
8. Applicable rules and regulations of local utility companies.
9. NECA 1-2006, Standard Practices for Good Workmanship in Electrical Contracting

C. All electrical equipment and material furnished under Division 16 shall conform to all CEC requirements and bear the Underwriters' Laboratories (UL) label where applicable.

D. Nothing in the Construction Documents shall be construed to permit work not conforming to these Codes. Whenever the indicated material, workmanship, arrangement or construction is of high quality or capacity than that required by the above rules and regulations, the Construction Documents shall take precedence. Should there be any direct conflict between the rules and regulations and Construction Documents, the rules shall govern.

E. All electrical equipment and material furnished under this Division shall conform to NEMA and ASTM standards, CEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.

F. All electrical work shall conform to manufacturer's written instruction, and the NECA Standard Practices for Good Workmanship in Electrical Contracting and all published recommended practices at the time of project. The Contractor shall use the requirements within the Specifications whenever they exceed NECA guidelines.

G. Follow manufacturer's direction where these direction cover points not included with the Construction Documents.

1.07 DELIVERY, STORAGE AND HANDLING

A. Packing, shipping, handling and unloading

1. Damage to the equipment delivered to the site or in transit to the job shall be the responsibility of the Electrical Contractor.

2. Equipment and material delivery of shall be scheduled as required for timely, expeditious progress of work.

B. Storage and protection of job equipment is the responsibility Contractor.

C. Comply with Division 1 requirements with regards to waste management and disposal.

1.08 PROJECT CONDITIONS

A. Discrepancies

1. In the event of discrepancies with the Contract Documents, Engineer shall be notified with sufficient time as stated within Division 1 to allow the issuing of an addendum prior to the bid opening.

2. If, in the event that time does not permit notification of clarification of discrepancies prior to the bid opening, the following shall apply:

a. The drawings govern in matters of quantity and specifications govern in matters of quality.

b. In the event of conflict within the drawings and specifications involving quantities or quality, the greater quantity or higher quality shall apply. Such discrepancies shall be noted and clarified within the contractor's bid. No additional allowances will be made because of errors, ambiguities or omissions which reasonably should have been discovered during the bid preparation.

B. Verify all power and communication utilities' requirements prior to commencement of any utility work. Make proper adjustments to the construction to satisfy the serving utility.

C. Information shown relative to services is based upon available records and data, but shall be regarded as approximate only. Make minor deviations found necessary to conform to actual locations and conditions without extra cost. Verify locations and elevations of utilities prior to commencement of excavation for new underground installation.

D. Exercise extreme care in excavating near existing utilities to avoid any damage thereto; be responsible for any damage caused by such operations. Contact all utility companies to obtain exact locations prior to commencement of construction.

E. The electrical plans indicate the general layout and arrangement; the field conditions shall determine exact locations. Field verify all conditions and modify as required to satisfy design intent. Maintain all required working clearances.

F. Fees, permits and utility services

1. Obtain and pay for all permits and service charges required for the installation of this work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Arrange for all utility connections and pay charges incurred including excess service charges if any.

2. Extra charges imposed by the electrical and communication utility companies shall be included in the bid, if available. Unless otherwise stated, these charges will be assumed to include in the bid.

G. Provide and maintain temporary construction power. The General Contractor will pay for electric energy charges. Should the Electrical Contractor be the prime contractor, the Electrical Contractor shall pay for energy charges unless negotiated with Owner.

1.09 SEQUENCING

A. Coordinate work within phasing plans as provided by the Owner.

1.10 WARRANTY

1. Refer to City Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials mentioned herein or on Drawings require that the items be provided and of quality noted or an approved equal. All materials shall be new, full weight, standard in all respects and in first-class condition. Insofar as possible, all materials used shall be of the same brand or manufacturer throughout for each class of material or equipment.

B. Trade names or catalog numbers stated herein indicates grade or quality of material desired. Materials, where applicable, shall be UL labeled and in accordance with NEMA standards.

C. Dimensions, sizes and capacities shown are a minimum. Do not make changes without written permission of Engineer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Construction Documents and Site; be familiar with types of construction where electrical installation is involved. Note carefully other sections of Specifications with their individual cross-references, standard details, etc.

B. Any electrical work or materials shown either in Construction Documents, but not mentioned herein, or vice versa, shall be executed the same as if mentioned herein, in a workmanlike manner in accordance with all published NECA Standards of Installation.

C. Coordinate work with other crafts to avoid conflicts and check all outlet locations with drawings and specifications. Make minor adjustments without additional cost to Owner.

D. Engineer will make clarifications and rulings concerning any obvious discrepancies or omissions in work prior and after bidding. Perform all work involved in correcting obvious errors or omissions after award of contract as directed by Engineer at Contractor's expense.

E. Examine site dimensions and locations against Drawings and become informed of all conditions under which work is to be done before submitting proposals. No allowance will be made for extra expense due to error.

F. Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial) but shall be followed as closely as possible. Construction Documents are for assistance and guidance, and exact locations, distance, levels, etc., will be governed by construction; accept same with this under standing.

G. Horsepower of motors or wattage of equipment indicated in Construction Documents is estimated horsepower or wattage requirement of equipment furnished under other sections of Specifications. Size all feeders (conduit and wiring), motor starters, overload protection and circuit breakers to suit horsepower of motors or wattage of equipment actually furnished under various sections of specifications. However, in no case shall feeders and branch circuits (conduit and wiring) and circuit breakers be of smaller capacities or sizes than those indicated on Drawings or specified, unless approved in writing by Engineer.

3.02 PREPARATION

A. Seal all exterior wall penetrations in an approved watertight manner and to the satisfaction of Engineer and Owner.

B. Channels, joiners, hangers, caps, nuts and bolts and associated parts shall be plated electrolytically with zinc followed immediately thereafter by treating freshly deposited zinc surfaces with chromic acid to obtain a surface which will not form a white deposit on surface for an average of 120 hours when subjected to a standard salt spray cabinet test, or shall be hot dipped galvanized

3.03 INSTALLATION

A. Equipment identification

1. Properly identify panelboards, remote control switches, push buttons, terminal boxes, etc. with a descriptive nameplate. Make nameplate with 3/32" laminated plastic with black background and white letters. Machine engraved letters 1/8" high for equipment in device box(es) and 1/4" high for panelboards, terminal cabinets or larger items. Punched strip type nameplates and cardholders in any form are not acceptable. Fasten nameplates with oval head machine screws, tapped into front cover/panel.

B. Working spaces

1. Provide adequate working space around electrical equipment in compliance with Article 4 of Electrical Safety Orders and CEC 110.26. In general, provide 78" of headroom and 30" wide minimum clear workspace in front of panelboards and controls. In addition to the above, provide the following minimum working clearances:

   a. 0V – 150V (line-to-ground) provide 36" minimum clear distance.

   b. 151V – 600V (line-to-ground) provide 42" minimum clear distance.

C. Equipment supports

1. Anchor all electrical equipment to structure. Support systems shall be adequate to withstand seismic forces per CBC.

D. Excavating and backfilling

1. Excavate and backfill as required for installation of Work. Restore all surfaces, roadways, walks, curbs, walls existing underground installations, etc., cut by installations to original condition in an acceptable manner. Maintain all warning signs, barricades, flares and lanterns as required by ESO and local ordinances.

2. Dig trenches straight and true to line and grade, with bottom clear of any rock points. Support conduit for entire length on undisturbed original earth. Minimum conduit depth of pipe crown shall be 24" below finished or natural grade, unless otherwise noted.

E. Forming, cutting and patching

1. In new construction, General Contractor shall provide any special forming, recesses, chased, etc., and provide wood blocking, backing and grounds as necessary for the proper installation of electrical work. Be responsible for notifying General Contractor that such provision is necessary; layout work and check to see that it suits his requirements.

   a. Provide metal backing plates, anchor plates and such that are required for anchorage of electrical work under Division 26; securely weld or bolt to metal

framing. Wood blocking or backing will not be permitted in combination with metal framing.

2. Be responsible for proper placement of pipe sleeves, hangers, inserts and supports for this Work.

F. Concrete work

1. Provide concrete work related solely to electrical work. Concrete work, including forming and reinforcing steel installed for all electrical work, shall comply with all applicable requirements of Division 03 30 10, or in accordance with the State of California Standard Specifications issued by the Department of Transportation (CALTRANS).

3.04 REPAIR/RESTORATION

A. Cutting, patching and repairing of existing construction to permit installation of work under Division 26 is the responsibility of Contractor. Repair or replace all damage to existing work in kind to Owner's satisfaction.

B. Obtain Engineer's approval prior to performing any cutting or patching of concrete, masonry, wood or steel structure within building.

3.05 FIELD QUALITY CONTROL

A. Inspection of work

1. Working parts shall be readily accessible for inspection, repair and renewal. The right is reserved to make reasonable changes in equipment location shown on Drawings prior to rough in without additional costs to the Owner.

2. During construction all work will be subject to observation by the Engineer and his representatives. Assist in ascertaining any information that maybe required.

3. Do not allow or cause any work installed hereunder to be covered up or enclosed before it has been inspected and approved. Should any work be enclosed or covered prior to approval, uncover work, and after it has been inspected and approved, restore work of all others to the condition in which it was found at the time of cutting, all without additional costs to Owner.

B. Furnish all testing equipment as maybe required.

C. Test all wiring and connections for continuity and grounds; where such tests indicate faulty insulation or other defects, locate, repair and re-test.

D. Check rotation of all motors and correct if necessary.

3.06 CLEANING

A. Repair or replace all broken, damaged or otherwise defective parts without additional cost to Owner and leave entire work in a condition satisfactory to Engineer. At completion, carefully clean and adjust all equipment, fixtures and trim installed as part of this work; leave systems and equipment in satisfactory operating condition.

B. Clean out and remove from the site all surplus materials and debris resulting from this work; this includes surplus excavated materials.

3.07 DEMONSTRATION

A. At project completion, Contractor shall allot a period of not less than 8 hours per well site for instruction of operating and maintenance personnel in the use of all systems installed under this Division. This time is in addition to any instruction time stated in the Specifications of other sections for other equipment (i.e., fire alarm, security, intercom, etc.). All personnel shall be instructed at one time, the Contractor shall make all necessary arrangements with manufacturer's representatives as may be required. Contractor, if any, for the above services shall pay all costs.

3.08 PROTECTION

A. In performance of work, protect work of other trades as well as work under this Division from damage.

B. Protect electrical equipment, stored and installed, from dust, water or other damage.

END OF SECTION

SECTION 26 05 19
CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary for the installation of all conductors and cables under this Section related to lighting, power, mechanical, control and signal systems.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ASTM -American Society for Testing and Materials
   a. B3; Standard Specification for Soft or Annealed Copper Wire
   b. B8; Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
   c. B787/B787M; Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation
   d. D1000; Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
2. CCR –California Code of Regulations, Title 24
   a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. UL -Underwriters Laboratories, Inc.
   a. UL 83; Thermoplastic-Insulated Wire and Cables
   b. UL 486A 486B; Wire Connectors
   c. UL 486C; Splicing Wire Connectors
   d. UL 486D; Standard for Insulated Wire Connector Systems For Underground Use Or In Damp Or Wet Locations

e. UL 486E; Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

f. UL 493; Thermoplastic-Insulated Underground Feeders and Branch Circuit Cables

g. UL 510; Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

h. UL 854; Service-Entrance Cables

4. NEMA –National Electrical Manufacturer's Association

   a. WC 70-1999; Nonshielded Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy

5. IEEE –Institute of Electrical and Electronic Engineers

   a. 82; Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors

1.03 DELIVERY

A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

A. Conductor material

1. Provide annealed copper for all wire, conductor and cable of not less than 98% conductivity.
2. Wire #8 AWG and larger shall be stranded.
3. Wire #10 AWG and smaller may be stranded as long as the device being connected is listed from use with stranded wire. Under no circumstance will crimped terminals be allowed to make the installed Code compliant.

B. Insulation material

1. All insulated wire, conductor and cable shall be 600 Vac rated.
2. Feeder and branch circuits larger than #6 AWG shall be type THW, XHHW or THHN/THWN.
3. Feeder and branch circuits #6 AWG and smaller shall be type TW, THW, XHHW or THHN/THWN.
4. Control circuits shall be type THW or THHN/THWN.
5. Wires shall bear the UL label marked with gauge, type and manufacturer's name on 24" centers.
6. Insulation color shall match identification stated within these Specifications. The application of phase taping for conductors will not be permitted.

2.02 FLEXIBLE CORDS AND CABLES

A. Provide flexible cords and cables of size, type and arrangement as indicated on Drawings.

B. Type S flexible cords and cable shall be manufactured in accordance with CEC Article 400 and composed of two or more conductors and a full sized green insulated grounding conductor with an outer rubber or neoprene jacket.

C. Flexible cords and cables shall be fitted with wire mesh strain relief grips either as a integral connector component or an independently supported unit.

D. Suspended flexible cords and cables shall incorporate safety spring(s).

2.03 WIRE CONNECTIONS AND TERMINATIONS

A. Electrical spring wire connectors

1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-sectional steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.

2. Self-striping pigtail and tap U-contact connectors are not acceptable.

B. Compression type terminating lugs

1. Provide tin-plated copper high compression type lugs for installation with hand or hydraulic crimping tools as directed by manufacturer. Notch or single point type crimps are not acceptable.

2. Two-hole, long barrel lugs shall be provided for size #4/O AWG and larger wire where terminated to bus bars. Use minimum of three crimps per lug where possible.

C. Splicing and insulating tape

1. Provide black, UV resistant, self extinguishing, 7 mil thick vinyl general purpose electrical tape per UL 510 and ASTM D1000. 3M Scotch 33 or equal.

D. Insulating putty

1. Provide pads or rolls of non-corrosive, self-fusing, 125 mil thick rubber putty with PVC backing sheet per UL 510 and ASTM D1000. 3M Scotchfil or equal.

E. Insulating resin

1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. 3M Scothcast 4 or equal.

2. Use resin with thermal and diaelectric properties equal to the cable’s insulating properties.

F. Terminal strips

1. Provide box type terminal strips in the required quantities plus 25% spare. Install in continuous rows.

2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.

3. Identify all terminals strips and circuits.

G. Crimp type connectors

1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support.
2. Fasten crimp type connectors or terminals using a crimping tool recommended by the manufacturer.
3. Provide insulated overlap splices with tinned seamless electrolytic copper-brazed barrel with funnel wire entry and insulation support.
4. Provide insulated butt splices with tinned seamless electrolytic copper-brazed barrel with center stop, funnel wire entry and insulation support.

H. Cable ties

1. Provide harnessing and point-to-point wire bundling with nylon cable ties. Install using tool supplied by manufacturer as required.

I. Wire lubricating compound

1. UL listed for the wire insulation and conduit type, and shall not harden or become adhesive.
2. Shall not be used on wire for isolated type electrical power systems.

J. Bolt termination hardware

1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE Grade 5; or silicon bronze alloy ASTM B-9954 Type B.
2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, conforming to ANSI B27.2. SAE or narrow series shall be used.
4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
   a. 1/4” bolt – 125 A
   b. 5/16” bolt – 175 A
   c. 3/8” bolt – 225 A
   d. 1/2” bolt – 300 A
   e. 5/8” bolt – 375 A
   f. 3/4” bolt – 450 A

PART 3 - EXECUTION

3.01 EXAMINATION

A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

3.02 INSTALLATION

A. All wire, conductor, and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient conditions.

B. Feeders and branch circuits in wet locations shall be rated 75°C minimum.

C. Feeders and branch circuits in dry locations shall be rated 90°C minimum.

D. Minimum conductor size

1. #12 AWG copper for all power and lighting branch circuits.
2. #14 AWG copper for all line voltage signal and control wiring, unless otherwise indicated.

E. Remove and replace conductors under the following conditions at no additional costs to the Owner:

1. Installed within wrong specified conduit or raceway.
2. Damaged during installation.
3. Of insufficient length to facilitate proper splice of conductors

3.03 WIRING METHODS

A. Install wires and cable in accordance with manufacturer's written instructions, as shown on Drawings and as specified herein.

B. Install all single conductors within raceway system, unless otherwise indicated.

C. Parallel circuit conductors and terminations shall be equal in length and identical in all aspects.

D. Provide adequate length of conductors within electrical enclosures and neatly train to termination points with no excess. Terminate such that there is no bare conductor at the terminal.

E. Splice cables and wires only in junction boxes, outlet boxes, pull boxes, manholes or handholes.

F. Group and bundle with tie wrap each neutral with its associated phase conductors where more than one neutral conductor is present within a conduit.

G. Install cable supports for all vertical feeders in accordance with CEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.

H. Seal cable where exiting a conduit from an exterior underground raceway with a non-hardening compound (i.e., duct seal or equal).

I. Provide UL listed factory fabricated, solder-less metal connectors of size, ampacity rating, material, type and class for applications and for services indicated. Use connectors with temperature ratings equal or greater than the conductor or cable being terminated.

J. Stranded wire shall be terminated using fittings, lugs or devices listed for the application. Under no circumstances shall stranded wire be terminated solely by wrapping it around a screw or bolt.

K. Flexible cords and cables supplied as part of a pre-manufactured assembly shall be installed according to manufacturer's published instructions.

3.04 WIRING INSTALLATION IN RACEWAYS

A. Install wire in raceway after interior of building has been physically protected from weather, and all mechanical work likely to injure conductors has been completed.

B. Pull all conductors into raceway at the same time.

C. Use UL listed, non-petroleum base and insulating type pulling compound as needed.

D. Completely mandrel all underground or concrete encased conduits prior to installation.

E. Completely and thoroughly swab raceway system prior to installation

F. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors smaller than #1 AWG.

G. Wire pulling

1. Provide installation equipment that will prevent cutting or abrasion of insulation during installation.
2. Maximum pull tension shall not exceed manufacturer's recommended value during installation for cable being measured with tension dynometer.
3. Use rope made of non-metallic material for pulling.
4. Attach pulling lines by means of either woven basket grips or pulling eyes attached directly to the conductors.
5. Pull multiple conductors simultaneously within same conduit.

3.05 WIRE SPLICES, JOINTS AND TERMINATIONS

A. Join and terminate wire, conductors and cables in accordance with UL 486, CEC and manufacturer's instructions.

B. Thoroughly clean wires before installing lugs and connectors.

C. Make splices, taps and terminations to carry full conductor ampacity without perceptible temperature rise, and shall be made mechanically and electrically secure.

D. Terminate wires in terminal cabinets using terminal strips, unless otherwise indicated.

E. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere within panel or cabinet.

F. Encapsulate splices in wet locations using specified insulating resin kits.

G. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as feed conductor with at least 6 inches of tail, all neatly packed within box.

H. Where conductors are to be connected to metallic surfaces, coated surfaces shall be cleaned to base metal surface before installing connector. Remove lacquer coating of conduits where ground clamps are to be installed.

I. Branch circuits (#10 AWG and smaller) connectors shall comply with 2.03.A and 2.03.B above.

J. Branch circuits (#8 AWG and larger)

1. Join or tap conductors using insulated mechanical compression taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over-wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of joint.

2. Terminate conductors using mechanical compression lugs in accordance with manufacturer's recommendation or as specified elsewhere.

3. Field installed compression connectors for 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.

4. Insulate splices and joints with materials approved for the particular use, location, voltage and temperature.

K. Termination hardware assemblies

1. Al/Cu lugs connected to aluminum plated or copper bus shall be secured with steel bolt, flat washer (two per bolt), Belleville washer and nut.

2. Copper lugs connected to copper buss shall bus shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer and nut.

3. The crown of Belleville washers shall be under the nut.

4. Bolt assemblies shall be torque to manufacturer's recommendations. Where manufacturer recommendation is not obtainable, the following shall be used:

a. 1/4" -20 bolt at 80 inch-pound torque

b. 5/16" -18 bolt at 180 inch-pound torque

c. 3/8" -20 bolt at 20 inch-pound torque

d. 1/2" -20 bolt at 40 inch-pound torque

e. 5/8" -20 bolt at 55 inch-pound torque

f. 3/4" -20 bolt at 158 inch-pound torque

3.06 IDENTIFICATION

A. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.

B. Provide all terminal strips with each individual terminal identified using specified vinyl markers.

C. In manholes, pullboxes and handholes provide tags of embossed brass type with cable type and voltage rating. Attach tags to cable with slip-free plastic cable lacing units.

D. Color coding

1. For 120/208 Volt (or 120/240 Volt), 1 phase, 3 wire systems:
    a. Phase A – Black
    b. Phase B – Red
    c. Neutral – White
    d. Ground – Green
2. For 120/208 Volt, 3 phase, 4 wire systems:
    a. Phase A – Black
    b. Phase B – Red
    c. Phase C – Blue
    d. Neutral – White
    e. Ground – Green
3. For 277/480 Volt, 3 phase, 4 wire systems:
    a. Phase A – Brown
    b. Phase B – Orange
    c. Phase C – Yellow
    d. Neutral – Gray
    e. Ground – Green
4. Switch leg individually installed shall be the same color as the branch circuit to which they originate, unless otherwise indicated.
5. Travelers for 3-way and 4-way switches shall be a distinct color and pulled with the circuit switch leg or neutral.

3.07 FIELD QUALITY CONTROL

A. Supply labor, materials and test equipment required to perform continuity and ground tests.

B. Electrical testing

1. Perform feeder and branch circuit insulation test after installation and prior to connection to device.

2. Tests shall be performed by 600 Vdc megger for a continuous 10 seconds from phase-to-phase and phase-to-ground.
3. Torque test conductor connections and terminations for conformance to Specifications.
4. If any failure is detected, locate failure, determine cause and replace or repair cable to Engineer's satisfaction at no additional costs.
5. Furnish test results in type written report form for review by Engineer.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the item specified under this Section, including but not limited to power system grounding

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
   a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. IEEE –Institute of Electrical and Electronic Engineers
   a. 142; Recommend Practices for Grounding of Industrial and Commercial Power Systems
3. NFPA –National Fire Protection Association
   a. 780; Lightning Protection Code
4. UL –Underwriters Laboratories, Inc.
   a. 467; Grounding and Bonding Equipment

1.03 SYSTEM DESCRIPTION

A. This Section provides for the grounding and bonding of all electrical and communication apparatus, machinery, appliances, components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.

B. Ground the electrical service system neutral at service entrance equipment as shown on the Drawings.

C. Ground each separately derived system, as defined in CEC 250.5 (D) and on the Drawings, unless specifically noted otherwise.

D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, equipment and metallic raceways, boxes and cabinets shall be completely and effectively grounded in accordance with all CEC requirements, whether or not such connections are specifically shown or specified.

1.04 SUBMITTALS

A. Submit manufacturer's data for equipment and materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

PART 2 - PRODUCTS

2.01 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND)

A. #3/O AWG minimum bare stranded copper conductor.

2.02 DRIVEN (GROUND) RODS

A. Copper clad steel, minimum ¾" diameter by 10'-0" length, sectional type with copper alloy couplings and carbon steel driving stud; Weaver, Cadweld or equal.

2.03 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron body with 150°C molded plastic insulated throat and lay-in ground lug; OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

2.04 CONNECTION TO PIPE

A. Cable to pipe connections; OZ/Gedney G-100B series, Thomas & Betts #290X series or equal.

2.05 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPICES

A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds, Cadweld or equal, or high-pressure compression type connectors, Cadweld, Thomas & Betts or equal.

2.06 BONDING JUMPERS

A. OZ/Gedney Type BJ, Thomas & Betts #3840 series or equal.

2.07 GROUND CONDUCTOR

A. Ground conductor shall be code size UL labeled, Type THWN insulated copper wire, green in color.

2.08 MAIN BUILDING REFERENCE GROUND BUS (BGB)

A. Provide 1 24”x4”x1/4” TK copper bus bar mounted on wall with insulating stand-offs at +18” AFF. Furnish complete with cast copper alloy body Thomas Betts Series 310 or equal lugs for connecting grounding conductors. Attach lugs to bus with appropriate size bronze bolt, flat washer and Belleville washer. All connections shall be torque, and all holes shall be drilled and tapped for single hole lugs. Provide 4 spare lugs with respective spaces.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Grounding electrodes
   1. Concrete encased grounding electrode (Ufer ground)
      a. Provide a #3/O AWG minimum bare copper conductor encased along the bottom of concrete foundation, footing or trench which is in direct contact with the earth and where there is no impervious waterproofing membrane between the footing and soil. The electrode shall extend through a horizontal length of 30’ minimum and shall be encased in not less than 2” or more than 5” of concrete separating it from surrounding soil. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to BGB or as shown on Drawings.
   2. Supplementary grounding electrode (ground ring, grid and driven rod)
      a. Provide as shown driven ground rod(s). Interconnect ground rod with structural steel and adjacent rods with code size bare copper conductor. Ground rods shall be space no less than 6’-0” on centers from any other electrode or electrodes of another electrical system.
   3. Separately derived electrical system grounding electrode
      a. Ground each separately derived system per CEC 250-26 or as shown on Drawings, whichever is greater.
   4. Metal underground water pipe
      a. Contractor shall install am accessible grounding electrode conductor from the main incoming cold-water line to BGB. The electrode conductor shall be sized per CEC Table 250-94 or as shown on Drawings, whichever is greater.

B. Grounding electrode conductor

1. Provide grounding electrode conductors per CEC Table 250-94 or as shown on Drawings, whichever is greater.

C. Power system grounding

1. Connect the following items using code size copper grounding conductors to BGB or as shown on Drawings:
    a. Concrete encased electrode (Ufer ground)
    b. Ground rod(s)
    c. Incoming cold and fire water pipes
    d. Gas pipe
    e. Structural steel
    f. Distribution transformer secondary

D. Equipment Bonding/Grounding

1. Provide a code sized copper ground conductor, whether indicated or noted on the drawings, in each of the following:
    a. All power distribution conduits and ducts
    b. Distribution feeders
    c. Motor and equipment branch circuits
    d. Device branch circuits
2. Provide a separate grounding bus at distribution panelboards, loadcenters, switchboards and motor control centers. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35V above ground.
3. Metallic conduits terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
4. Provide bonding jumpers across expansion and deflection coupling in conduit runs, pipe connections to water meters and metallic cold-water dielectric couplings.
5. Provide ground wire in flexible conduit connected at each end via grounding bushing.
6. Provide bonding jumpers across all cable tray joints.
7. Bond each end of metallic conduit longer than 36” in length to grounding conductor using a #6 AWG pigtail.

3.02 FIELD QUALITY CONTROL

A. Contractor using test equipment expressly designed for that purpose shall perform all ground resistance tests in conformance with IEEE quidelines. Contractor shall submit typewritten records of measured resistance values to Engineer for review and approval prior to energizing the system.

B. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with the following resistance limits:

   1. Resistance from ground bus to ground electrode and to earth shall not exceed 5 ohms unless otherwise noted.

   2. Resistance from the farthest panelboard, loadcenter, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed 20 ohms maximum.

C. Inspection

   1. The Engineer or Inspector prior to encasement, burial or concealment thereto shall review the grounding electrode and connections.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to electrical conduits; outlet, junction and pull boxes; and related supports.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI –American National Standards Institute
    a. C33.91; Specification for Rigid PVC Conduit
    b. C80.1; Specification Rigid Steel Conduit, Zinc-Coated
    c. C80.3; Specification for Electrical Metallic Tubing, Zinc-Coated
    d. C80.6; Intermediate Metal Conduit (IMC), Zinc-Coated
2. CCR –California Code of Regulations, Title 24
    a. Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
    b. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. NECA –National Electrical Contractors Association
    a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT)
    b. 111, Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)
4. NEMA –National Electrical Manufacturer’s Association
    a. FB 1; Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

b. FB 2.10; Selection and Installation Guidelines for Fittings for Use with Non-flexible Electrical Metal Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)

c. FB 2.20; Selection and Installation Guidelines For Fittings for Use With Flexible Electrical Conduit and Cable

d. OS 1; Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

e. OS 3; Selection and Installation Guidelines for Electrical Outlet Boxes

f. RN 1; Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing

g. TC 2; Electrical Plastic Tubing and Conduit

h. TC 3; PVC Fittings for Use with Rigid PVC Conduit and Tubing

i. TC 14; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

5. OSHPD Anchorage Pre-approvals

a. OPA-0003; Superstrut Seismic Restraint System

b. OPA-0114; B-Line Seismic Restraints

c. OPA-0120; Unistrut Seismic Bracing System

d. OPA-0242; Power-Strut Seismic Bracing System

6. UL –Underwriter's Laboratories, Inc.

a. 1; Standard for Flexible Metal Conduit

b. 6; Rigid Metal Electrical Conduit

c. 360; Standard for Liquid-Tight Flexible Steel Conduit

d. 514A; Metallic Outlet Boxes, Electrical

e. 514B; Fittings for Conduit and Outlet Boxes

f. 651; Schedule 40 & 80 PVC Conduit

g. 797; Electrical Metallic Tubing

h. 1242; Intermediate Metal Conduit

i. 1684; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

1.03 SYSTEM DESCRIPTION

A. Furnish, assemble, erect, install, connect and test all electrical conduits and related raceway apparatus required and specified to form a complete installation.

1.04 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. Installation shall conform to the NECA installation guidelines unless otherwise indicated within this Section

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduits and Fittings

1. Rigid steel conduit (RMC)

   a. Conduit: Standard weight, mild steel pipe, and zinc coated on both inside and outside by a hot dipping or shearardizing process manufactured in accordance with UL 6 and ANSI C80.1 specifications.

   b. Fittings (couplings, elbows, bends, etc.)

      1) Shall be steel or malleable iron.

      2) Coupling and unions shall be threaded type, assembled with anti-corrosion, conductive and anti-seize compound at joints made absolutely tight to exclude water.

   c. Bushings

      1) Insulating bushings: Threaded polypropylene or thermosetting phenolic rated at 150°C minimum.

      2) Insulating grounding bushing: Threaded cast body with insulating throat and steel “lay-in” ground lug.

      3) Insulating metallic bushing: Threaded cast body with plastic insulated throat rated at 150°C minimum.

2. Coated rigid steel conduit (CRMC)

   a. Conduit: Equivalent to RMC with a Polyvinyl chloride (PVC) coated bonded to the galvanized outer surface of the conduit. The bonding between the PVC coating and conduit surface shall be ETL PVC-001 compliant. The coating thickness shall be a minimum of 40mil.

   b. Fittings (couplings, elbows, bends, etc.)

      1) Equivalent to RMC above with bonded coating same as conduit.

      2) The PVC sleeve over fittings shall extend beyond hub or coupling approximately one diameter or 1 1/2” whichever is smaller.

   c. Bushing equivalent to RMC above.

3. Intermediate metallic conduit (IMC)

   a. Conduit: Intermediate weight, mild steel pipe, meeting the same requirements for finish and material as rigid steel conduit manufactured in accordance with UL 1242 and ANSI C80.6 specifications.

   b. Fittings (couplings, elbows, bends, etc.) equivalent to RMC above.

c. Bushing equivalent to RMC above.

4. Electrical metallic tubing (EMT)
   a. Conduit: Cold rolled steel tubing with zinc coating on outside and protective enamel on inside manufactured in accordance with UL 797 and ANSI C80.3 specifications.
   b. Couplings: Steel or malleable iron with compression type fastener via a nut.
   c. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
5. Rigid non-metallic conduit (PVC)
   a. Conduit: PVC composed Schedule 40, 90°C manufactured in accordance with NEMA TC 2 and UL 651 specifications.
   b. Fittings: Molded PVC, slip on solvent welded type in accordance to NEMA TC 3.
6. Reinforced thermosetting resin conduit (RTRC)
   a. Conduit: Fiber impregnated with a cured thermosetting resin compound in accordance with NEMA TC 14 and UL1684.
   b. Fittings: Molded resin with glass reinforcement manufactured in the same process as the conduit bonded with an epoxy adhesive.
7. Flexible metallic conduit (FMC)
   a. Conduit: Continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 1.
   b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
8. Liquidtight flexible metallic conduit (LFMC)
   a. Conduit: PVC coated, continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 360.
   b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
9. Miscellaneous Fittings and Products
   a. Conduit sealing bushings: Steel or cast malleable iron body and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Supplied with neoprene sealing rings between body and PVC sleeve.
   b. Watertight cable terminators: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel screws and zinc plated cast iron locking collar.
   c. Watertight cable/cord connectors: Liquidtight steel or cast malleable iron body with sealing neoprene bushing and stainless-steel retaining ring.
   d. Expansion fittings: Multi-piece unit of hot dip galvanized malleable iron or steel body and outside pressure bussing design to allow a maximum of 4”

movement (2” in either direction). Furnish with external braid tinned copper bonding jumper. UL listed for both wet and dry locations.

e. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve; internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling to provide minimum of 3/4” movement and 30 degrees deflection from normal. UL listed for both wet and dry locations.

f. Conduit bodies: Raintight, malleable iron, hot-dip galvanized body with threaded hubs, stamped steel cover, stainless steel screws and neoprene gasket.

g. Other couplings, connectors and fittings shall be equal in quality, material and construction to items specified herein.

B. Boxes

1. Outlet boxes

a. Standard: Galvanized one-piece of welded pressed steel type in accordance with NEMA OS 1 and UL 514. Boxes shall not be less than 4” square and at least 1 1/2” deep.

b. Concrete: Galvanized steel, 4” octagon ring with mounting lug, backplate and adapter ring type in accordance with NEMA OS 1 and UL 514. Depth as required by application.

c. Masonry: Galvanized steel, 3.75” high gang box in accordance with NEMA OS 1 and UL 514.

d. Surface cast metal: Cast malleable iron body, surface mounted box with threaded hubs and mounting lugs as required in accordance with NEMA OS 1 and UL 514. Furnish with ground flange, steel cover and neoprene gasket.

2. Pull and junction boxes

a. Sheet metal boxes: Standard or concrete outlet box wherever possible; otherwise use 16-gauge galvanized sheet metal, NEMA 1 box sized per CEC with machine screwed cover.

b. Cast metal boxes: Install standard cast malleable iron outlet or device box when possible.

c. Flush mounted boxes: Install overlapping cover with flush head screws.

d. In-ground mounted pull holes/boxes: Install pre-cast concrete box, sized per Drawing or CEC with pre-cast or traffic rated lid.

3. Floor boxes

a. Floor boxes shall be adjustable, cast metal body with threaded conduit openings, adjustable rings, brass flange or Lexan ring and cover plate with threaded plug. Include provisions to accommodate surface mounted telephone or receptacle outlet, or flush floor mounted telephone or receptacle outlet where shown on Drawings.

C. Pull line/cord

1. Polypropylene braided line or Let-line #232 or equal of 1/8" diameter with a minimum break strength of 200 pounds.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

3.02 PREPARATION

A. Conduit

1. Provide all necessary conduit fittings, connectors, bushings, etc. required to complete conduit installation to meet the CEC and intended application whether noted, shown or specified within.
2. Location of conduit runs shall be planned in advance of the installation and coordinated with other trades.
3. Where practical, install conduits in groups in parallel vertical or horizontal runs that avoid unnecessary offsets.
4. All conduits shall be parallel or at right angles to columns, beams and walls whether exposed or concealed.
5. Conduits shall not be placed closer than 12" to a flue, parallel to hot water, steam line or other heat sources; or 3" when crossing perpendicular to the above said lines when possible.
6. Install exposed conduit as high as practical to maintain adequate headroom. Notify Engineer if headroom will be less than 102".
7. Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.
8. The largest trade size conduit in concrete floors and walls shall not exceed 1/3 thickness or be spaced a less than three conduit diameters apart unless permitted by Engineer. All conduits shall be installed in the center of slab or wall, and never between reinforcing steel and bottom of floor slab.
9. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
10. When installing underground conduits to specified depth; depth shall be taken from finished grade as it will be at project completion. Should finish grade be above existing grade by an amount equal to or greater than specified depth, conduit shall be installed not less than 6" below existing grade.
11. Verify that information concerning finish grade is accurate, for should the underground run be less than the specified depth, Contractor may be required to re-install conduit to meet the required depth.

12. Unless otherwise specified, underground conduits shall be installed with top side not less than 24” below finished grade; this depth applies to all conduits outside of building foundations including those under walks, open corridors or paved areas.
13. Utility company service conduits installation depth shall be as directed by their respective specifications and requirements.

B. Boxes

1. Before locating outlet boxes, check Construction Documents for type of construction and make sure that there is no conflict with other equipment. Locate outlet boxes as shown and locate so as not to interfere with other Work or equipment.
2. Install all outlet boxes flush within walls, ceiling and floors except where installed within non-finished rooms, cabinetry, attic spaces or as indicated on Drawings.
3. Locate pull boxes and junction boxes within concealed, accessible locations where possible.
4. Do not install outlet boxes back-to-back with same stud space. Where shown back-to-back, offset as required, and fill void with sound dampening material where requested by Owner.
5. In fire rated walls separate boxes by 24” minimum and with stud member.
6. Adjust position of outlet boxes within masonry wall to accommodate course lines.

3.03 INSTALLATION

A. Conduit

1. Minimum conduit size shall be 3/4” unless otherwise indicated.
2. All conduit work shall be concealed unless otherwise indicated. Exposed conduits shall be permitted within unfinished rooms/spaces to facilitate installation.
3. Install conduit in complete runs prior to installing conductors or cables.
4. Make long radius conduits bends free from kink, indentations or flattened surfaces. Make bends carefully to avoid injury or flattening. Bends 1 1/4” size and larger shall be factory made ells or be made with a manufactured mechanical bender. Heating of steel conduit to facilitate bending or that damage galvanized coating will not be permitted.
5. Remove burrs and sharp edges at end of conduit with tapered reamer.
6. Protect and cover conduits during construction with metallic bushings and bushing “pennies” to seal exposed openings.
7. Assemble conduit threads with anti-corrosion, conductive, anti-seize compound and tighten securely.
8. Install conduits shall that no traps to collect condensation exist.
9. Fasten conduit securely to boxes with locknuts and bushings to provide good grounding continuity.

10. Install pull cords/line within any spare or unused conduits of sufficient length to facilitate future cable installation.
11. Penetrations
    a. Locate penetrations within structural members as shown on Drawings and as directed by Engineer. Should it be necessary to notch any framing member, make such notching only at locations and in a manner as approved by Engineer.
    b. Do not chase concrete or masonry to install conduit unless specifically approved by Engineer.
    c. Cutting or holes
        1) Install sleeves for cast-in-place concrete floors and walls. After installing conduit through penetration, seal using dry pack grouting compound (non-iron bearing, chloride free and non-shrinking) or fire rated assembly if rated floor or wall. Use escutcheon plate on floor underside to contain compound as necessary.
        2) Cut holes with a hole saw for penetrations through non-concrete or non-masonry members.
        3) Provide chrome plated escutcheon plates at all publicly exposed wall, ceiling and floor penetrations.
    d. Sealing
        1) Non-rated penetration openings shall be packed with non-flammable insulating material and sealed with gypsum wallboard taping compound.
        2) Fire rated penetration shall be sealed using a UL classified fire stop assembly suitable to maintain the equivalent fire rating prior to the penetration.
        3) Use escutcheon plates to hold sealing or fire rated compound as necessary.
    e. Waterproofing
        1) Make penetrations through any damp-proofed/waterproofed surfaces within damp/wet locations as such as to maintain integrity of surface.
        2) Install specified watertight conduit entrance seals at all below grade wall and floor penetrations.
        3) At roof penetrations furnish roof flashing, counter flashing and pitch-pockets compatible to roof assembly.
        4) Where possible conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration’s exterior side.
        5) Make penetrations through floors watertight with mastic, even when concealed within walls or furred spaces.
12. Supports
    a. Conduits shall be support and braced per OSHPD pre-approved anchorage systems when those methods are implemented and installed.

b. Sizes of rods and cross channels shall be capable of supporting 4 times and 5 times actual load, respectively. Anchorage shall support the combined weight of conduit, hanger and conductors.

c. Support individual horizontal conduit 1 1/2" and smaller by means of 2-hole straps or individual hangers.

d. Galvanized iron hanger rods sizes 1/4" diameter and larger with spring steel fasteners, clips or clamps specifically design for that purpose for 1 1/2" conduits and larger.

e. Support multi-parallel horizontal conduits runs with trapeze type hangers consisting of 2 or more steel hanger rods, preformed cross channels, 'J' bolts, clamps, etc.

f. Support conduit to wood structures by means of bolts or lag screws in shear, to concrete by means of insert or expansion bolts and to brickwork by means of expansion bolts.

g. Support multi-parallel vertical conduits runs with galvanized Unistrut, Power-Strut or approved equal type supports anchored to wall. Where multi-floored conduits pass through floors, install riser clamps at each floor.

h. Maximum conduit support spacing shall be in accordance with NECA Standard of Installation:

   1) Horizontal runs:

      a) 3/4" and smaller at 60" on centers, unless building construction prohibits otherwise, then 84" on centers.

      b) 1" and larger at 72" on centers, unless building construction prohibits otherwise or any other condition, then 120" on centers.

   2) Vertical runs:

      a) 3/4" and smaller @ 84" on centers.

      b) 1" and 1 1/4" @ 96" on centers.

      c) 1 1/2" and larger @ 120" on centers.

      d) Any vertical condition such as shaftways and concealed locations for any sized conduit, 120" on centers.

i. Anchorage for RMC/IMC supports unless otherwise specified:

   1) < 1" IMC/RMC = #10 bolt/screw.

   2) 1" IMC/RMC = 1/4" bolt/screw.

   3) 1 1/2" and 2" IMC/RMC = 3/8" bolt/screw.

   4) 3" IMC/RMC, 4" EMT = 1/2" bolt/screw.

   5) > 3" IMC/RMC = 5/8" bolt/screw.

j. Anchorage for EMT supports unless otherwise specified:

   1) < 1 1/2" EMT = #10 bolt/screw.

   2) 1 1/2" EMT = 1/4" bolt/screw.

3) 2, 2 1/2” and 3” EMT = 3/8” bolt/screw.

4) 4” EMT = 1/2” bolt/screw.

5) > 4” EMT = 5/8” bolt/screw.

B. Boxes

1. Install boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
2. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
3. Install plaster rings on all outlet boxes in stud walls or in furred, suspended or exposed ceilings. Covers shall be of a depth suited for installation.
4. Provide gasketed cast metal cover plates where boxes are exposed in damp or wet locations
5. Install access door for boxes installed within concealed locations without access.
6. Install approved factory-made knockout seal where knockouts are not present.
7. Refer to Architectural interior elevations and details shown for exact mounting heights of all electrical outlets. In general, locate outlets as shown or specific and complies with Americans with Disabilities Act:
   a. Convenience outlets: +18” AFF or +6” above counter or splash.
   b. Local switches: +48” AFF or +6” above counter or splash.
   c. Telecommunication outlets: +18” AFF or +48”AFF for wall telephone or intercom device.
   d. Verify all mounting heights with Drawings, and where heights are not suited for construction or finish please consult Engineer.
8. Use conduit bodies to facilitate pulling of conductor or cables or change conduit direction. Do not splice within conduit bodies.
9. Enclose pull box with additional rated gypsum board as necessary to maintain wall’s original fire rating.
10. Install galvanized steel coverplates on all open boxes within dry listed areas.
11. Install in-ground pull holes/boxes flush to grade finish at finished areas or 1” above finished landscaped grade. Seal all conduits terminating in pull hole/box watertight. Install and grout around bell ends where shown. Cover and lids shall be removable without damage to adjacent finish surfaces.
12. Support
    a. Accurately place boxes for finish, independently and securely supported by adequate blocking or manufacturer channel type heavy-duty box hangers for stud walls. Do not use nails to support boxes.
    b. Support boxes independent of conduit system.

c. Mount boxes installed within ceilings to 16-gauge metal channel bars attached to main runners or joists.

d. Support boxes within suspended acoustical tile ceilings directly from structure above when light fixture are to be installed from box.

e. Use auxiliary plates, bar or clips and grouted in place for masonry, block or pour-in-place concrete construction.

3.04 APPLICATION

A. Conduit

1. RMC/IMC suitable for all damp, dry and wet locations except when in contact with earth. IMC not suitable for hazardous locations as stated within CEC.
2. CRMC suitable for damp or wet locations, concealed within concrete or in contact with earth.
3. EMT suitable for exposed or concealed dry, interior locations.
4. PVC/RTRC suitable for beneath ground floor slab, except when penetrating, and direct earth burial. Do not run exposed within concrete walls or in floor slab unless indicated on Drawings or per Engineer's permission.
5. FMC suitable for dry locations only for connections to motors, transformers, vibrating equipment/machinery, controllers, valves, switches and light fixtures in less than 6 foot lengths.
6. LFMC application same as FMC above but for damp or wet locations.

B. Termination and joints

1. Use raceway fittings compatible with associated raceway and suitable for the location.
2. Raceways shall be joined using specified couplings or transitions where dissimilar raceway systems are joined.
3. Conduits shall be securely fastened to cabinets, boxes and gutters using (2) two locknuts and insulating bushing or specified insulated connector. Where joints cannot be made tight and terminations are subject to vibration, use bonding jumpers, bonding bushings or wedges to provide electrical continuity of the raceway system. Use insulating bushings to protect conductors where subjected to vibration or dampness. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
4. Terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
5. Stub freestanding equipment conduits through concrete floors for connections with top of coupling set flush with finished floor. Install plugs to protect threads and entrance of debris.
6. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating within interior switchboard, panel, cabinet or gutters. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.

7. Where conduits enter building from below grade inject into filled raceways pre-formulated rigid 2 lbs. density polyurethane foam suitable for sealing against water, moisture, insects and rodents.
8. Install expansion fitting or expansion/deflection couplings per manufacturer's recommendations where:
    a. Any conduit that crosses a building structure expansion joint; secure conduit on both sides to building structure and install expansion fitting at joint.
    b. Any conduit that crosses a concrete expansion joint; install expansion/deflection at joint.
    c. Any conduit greater than 1-1/4" is routed along roof top in runs greater than 100 feet; install expansion fittings every 100 feet.
    d. Engineer may allow FMC or LFMC in lieu of expansion fitting or expansion/deflection couplings on conduits 2" and smaller within accessible locations upon further review and written consent.

C. Boxes
1. Standard type suitable for all flush installations and all dry concealed locations.
2. Concrete type suitable for all flush concrete installations.
3. Masonry type suitable for all flush concrete and block installations.
4. Surface cast meta type suitable for all exposed damp and wet surface mounted locations, and dry surface mounted locations less than 96" from finished floor

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:
   1. Identifying electrical, instrumentation, and process equipment and components.
   2. Material, manufacturing, and installation requirements for identification devices.

B. Related Sections:
   1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its subcontractors to review all sections to ensure a complete and coordinated project.

1.02 REFERENCES

A. Refer to Section 26 05 00.

1.03 DEFINITIONS

A. Refer to Section 26 05 00.

1.04 SYSTEM DESCRIPTION

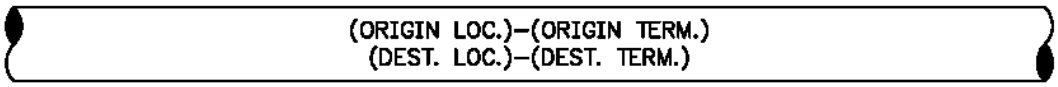
A. Nameplates:
   1. Provide a nameplate for each control device or major item of electrical equipment, either located in the field or within panels.
   2. Provide all nameplates of identical style, color, and material throughout the facility.
   3. Device nameplates information:
      a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.
      b. Device tag and loop number ID (e.g. EDV-60.0101.01).
      c. Circuit ID (e.g. LPA-11).
      d. Area served (e.g. Lighting Chemical Building).

B. Wire Numbers:
   1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:
      a. Wire numbers shall correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.
      b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.
      c. Internal panel wires on a common terminal shall have the same wire number.

d. All instrumentation cables shall be identified at pull points as described above.

2. Provide the following wiring numbering schemes throughout the project for field wires between Process Control Module, (PCM), Vendor Control Panels, (VCP), Motor Control Centers, (MCC), field starters, field instruments, etc.

OR



Where:

ORIGIN LOC. = Designation for originating panel or device
ORIGIN TERM. = Terminal designation at originating panel or device
DEST. LOC. = Designation for destination panel or device
DEST. TERM. = Terminal designation at destination panel or device or PLC I/O address at destination panel

a. Identify equipment and field instruments as the origin.
b. PCM's are always identified as the destination.
c. Location is the panel designation for VCP, LCP, or PCM. For connections to MCC's, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.
d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multiconductor cables, all terminal numbers shall be shown, separated by commas.
e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (e.g.T1, T2, T3, etc.).
f. Terminal designations at PCM's where the field conductor connects to a PLC input or output shall be the PLC address (Note: the following PLC I/O numbering scheme is typical for Allen Bradley, the numbering scheme should be modified to match that of the actual PLC manufacturer used for the project):
   1) Discrete Point: W:X:Y/Z
      Analog Point: W:X:Y.Z

      Where:
      W = I for input, O for output
      X = PLC number (1, 2, 3…)
      Y = Slot number (01, 02, 03…)
      Z = Terminal number (00,01,02…) for a discrete point or a word number for an analog point (1,2,3…)
g. Terminal designations at PCM's where the conductor does not connect to a PLC I/O point shall be the terminal number with a "C" prefix (e.g.

010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with “A” (e.g.. C0010A).

3. **Case 1**: Vendor Control Panel (VCP) to Process Control Module (PCM):
   Field Wire Number/Label: A-B/C-D
   A = Vendor Control Panel number without hyphen (VCP60.0101.01)
   B = Terminal number within VCP (manufacturer’s or vendor’s standard terminal number)
   C = Process Control Module number without hyphen (PCM60.0101)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “C” prefix if not connected directly to a PLC I/O point (C0010)

   Examples: VCP60.0101.01-10/PCM60.0101-I:1:01/01
   VCP60.0101.01-10/PCM60.0101-O:1:10/07
   VCP60.0101.01-10/PCM60.0101-C0100

4. **Case 2**: Field Instrument to Process Control Module (PCM):
   Field Wire Number/Label: E-F/C-D
   C = Process Control Module number without hyphen (PCM60.0101)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “C” prefix if not connected directly to a PLC I/O point (C0010)
   E = Field mounted instrument tag and loop numbers without hyphen (EDV60.0101.01)
   F = Manufacturer’s standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma

   Examples: TIT60.0101.01-2,3/PCM60.0101-I:1:01.1
   TSH60.0101-1/PCM60.0101-I:2:01/00

5. **Case 3**: Motor Control Center (MCC) to Process Control Module (PCM):
   Field Wire Number/Label: G-B/C-D
   B = Terminal number within Motor Control Center (manufacturer’s or vendor’s standard terminal number)
   C = Process Control Module without hyphen (PCM60.0101)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “C” prefix if not connected directly to a PLC I/O point (C0010)
   G = Actual starter designation in the Motor Control Center without hyphen (MMS60.0101)

   Examples: MMS60.0101-10/PCM60.0101-I:1:01/01
   MMS60.0101-10/PCM60.0101-O:1:10/07
   MMS60.0101-10/PCM60.0101-C0100

6. **Case 4**: Motor Control Center (MCC) to Vendor Control Panel (VCP):
   Field Wire Number/Label: G-B/A-B
   A = Vendor Control Panel number without hyphen (VCP60.0101.01)
   B = Terminal number within motor control center or vendor control panel (manufacturer’s or vendors standard terminal number)

G = Actual starter designation in the Motor Control Center without hyphen (MMS60.0101)

Example: MMS60.0101-X2/VCP60.0101.01-10

7. **Case 5**: Motor leads to a Motor Control Center (MCC): Field Wire Number/Label: H-I/G-B
   B = Terminal number within motor control center (manufacturer's standard terminal number)
   G = Actual starter designation in the Motor Control Center without hyphen (MMS60.0101)
   H = Equipment tag and loop number without hyphen (PMP60.0101.01)
   I = Motor manufacturer's standard motor lead identification (e.g.T1, T2, T3, etc.)

   Example: PMP-60.0101.01-T3/MMS60.0101.01-T3

8. **Case 6**: Remote or separately mounted starter or Variable Frequency Drive (VFD) to Process Control Module (PCM): Field Wire Number/Label: J-B/C-D
   B = Terminal number within starter or Variable Frequency Drive (manufacturer's standard terminal number)
   C = Process Control Module number without hyphen (VCP60.0101.01)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
   J = Starter or Variable Frequency Drive tag and loop number without hyphen (MMS60.0101)

   Examples: MMS60.0101-10/PCM60.0101.01-I:1:01/01
   MMS60.0101-10/PCM60.0101.01-O:2:10/07
   MMS60.0101-10/PCM60.0101.01-C0010

9. Terminate all spare conductors on terminal blocks and identify as required for other field wires with an "S" prefix:

   Example: S MMS60.0101-10/PCM60.0101.01-C011

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01 33 00 and 26 05 00.

B. Product Data:
   1. Nameplates:
      a. Color.
      b. Size:
         1) Outside dimensions.
         2) Lettering.
      c. Material.
      d. Mounting means.
   2. Nameplate Schedule:
      a. Show exact wording for each nameplate.
      b. Include nameplate and letter sizes.

3. Wire Numbers:
   a. Manufacturer's catalog data for wire labels and label printer.

C. Record Documents:
   1. Update the conduit schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.

1.06 QUALITY ASSURANCE

A. Schedule a pre-installation conference in accordance with Section 26 05 00 in order to clearly define the requirements specified for equipment identification:
   1. Representatives of the CONTRACTOR, OWNER, and ENGINEER shall convene before any major purchases of cable or conductors and before the installation or termination of any cables or conductors.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 26 05 00.

1.08 WARRANTY

A. Refer to Section 26 05 00.

1.09 SYSTEM START UP

A. Refer to Section 26 05 00.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nameplates and Signs:
   1. One of the following or equal:
      a. Brady.
      b. Seton.

B. Conductor and Cable Markers:
   1. Heat-shrinkable tubing:
      a. One of the following or equal:
         1) Raychem.
         2) Brady.
         3) Thomas & Betts.
         4) Kroy.

C. Conduit and Raceway Markers:
   1. One of the following or equal:
      a. Almetek: Almetek type mini-tag.
      b. Lapp Group: Maxi System

D. Medium Voltage Raceway Voltage Labels:
   1. One of the following or equal:
      a. Brady.
      b. Seton.

2.02 MATERIALS

A. Nameplates:
   1. Fabricated from white-center and red or black face laminated plastic engraving stock:
      a. 3/32-inch thick material.
      b. Two-ply.
      c. With chamfered edges.
      d. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:
         1) No characters smaller than 1/8-inch in height.

B. Signs:
   1. Automatic equipment and high voltage signs:
      a. Suitable for exterior use.
      b. In accordance with OSHA regulations.

C. Conductor and Cable Markers:
   1. Machine printed black characters on white tubing.
   2. Ten point type or larger.

D. Conduit and Raceway Markers:
   1. UV resistant holder and letters.
   2. Black letters on yellow background.
   3. Minimum 1/2-inch high letters.

E. Medium Voltage Circuit Raceway Labels:
   1. Vinyl plastic.
   2. Minimum 1-inch high letters.

2.03 SOURCE QUALITY CONTROL

A. Nameplates:
   1. Provide all nameplates for control panel operator devices (e.g. pushbuttons, selector switches, pilot lights, etc.):
      a. Same material and same color and appearance as the device nameplates, in order to achieve an aesthetically consistent and coordinated system.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Section 26 05 00.

B. Nameplates:
   1. Attach nameplates to equipment with rivets, bolts or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
   2. On NEMA 4or NEMA 4X enclosures, use epoxy-based cement to attach nameplates.
   3. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:
      a. Misaligned or crooked nameplates shall be remounted, or provide new enclosures at the discretion of the ENGINEER.

C. Conductor and Cable Markers:
   1. Apply all conductor and cable markers before termination.
   2. Heat-shrinkable tubing:
      a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.
      b. Tubing shall be tight on the wire after it has been heated.
      c. Characters shall face the open panel and shall read from left to right or top to bottom.
      d. Marker shall start within 1/32 inch of the end of the stripped insulation point.

D. Conduit Markers:
   1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
      a. Conduit markings shall match the conduit schedule; refer to Section 26 05 53.
   2. Mark conduits at the following locations:
      a. Each end of conduits that are greater than 10 feet in length.
      b. Where the conduit penetrates a wall or structure.
      c. Where the conduit emerges from the ground, slab, etc.
      d. The middle of conduits that are 10 feet or less in length.
   3. Mark conduits after the conduits have been fully painted.
   4. Position conduit markers so that they are easily read from the floor.
   5. Secure all conduit markers with nylon cable ties:
      a. Provide with ultraviolet resistant cable ties for conduit markers exposed to direct sunlight.
      b. Adhesive labels are not acceptable.
   6. Mark conduits before construction review by ENGINEER for punch list purposes.

E. Medium Voltage Raceway Labels:
   1. Apply at 50 foot intervals stating the voltage level contained within the raceway.

F. Signs and Labeling:
   1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
      a. Fasten warning signs with round head stainless steel screws or bolts.
      b. Locate and mount in a manner to be clearly legible to operations personnel.

2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc. where the voltage exceeds 600 volts.
3. Furnish and install warning signs on equipment that has more than one source of power.
   a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.
4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.
   a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.

3.02 FIELD QUALITY CONTROL

A. Replace any nameplates, signs, conductor markers, cable markers, or raceway labels that in the sole opinion of the ENGINEER do not meet the ENGINEER's aesthetic requirements.

END OF SECTION

SECTION 26 05 73

ELECTRICAL SYSTEM STUDIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:
   1. Short Circuit Fault Analysis Study.
   2. Protective Device Coordination Study.
   3. Arc-Flash Hazard Study.

B. Related Sections:
   1. Contract documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the CONTRACTOR and its subcontractors to review all sections to ensure a complete and coordinated project.

1.02 REFERENCES

A. Refer to Section 26 05 00.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (Red Book).
   2. 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
   3. 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
   4. 1015 - IEEE Recommended Practice For Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems - Corrigendum 1 (Blue Book).
   5. 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations.
   6. 315 - IEEE Standards Electrical and Electronics Graphic and Letter Symbols and Reference Designations.
   7. 902 - IEEE Guide for Maintenance, Operation and Safety on Industrial and Commercial Power Systems (Yellow Book).

C. National Fire Protection Association (NFPA):
   1. 70E - Standard for Electrical Safety in the Workplace.

1.03 DEFINITIONS

A. Refer to Section 26 05 00.

1.04 SYSTEM DESCRIPTIONS

A. The Study shall be performed under the direction of a licensed Professional Engineer in goodstanding with the California Board for Professional Engineers and Land Surveyors.

B. General study requirements:
   1. Scope:
      a. The short-circuit fault analysis, protective device coordination and arc- flash hazard studies shall include all equipment in the power distribution system including but not limited to:
         1) Utility equipment.
         2) Switchgear.
         3) Generators.
         4) Transformers:
            a) Including all dry-type transformers.
         5) Motor Control Centers.
         6) Free standing variable frequency drives and starters.
         7) Disconnect Switches.
         8) Motors.
         9) Panelboards:
            a) Including all 240 and 208 volt systems.
         10) Vendor Control Panels.
         11) HVAC Equipment. b.

         Study Scenarios:
         1) The studies shall include all possible electrical system configurations, for example:
            a) Operation on normal (utility) source.
            b) Operation on generator source.
            c) Main-breakers closed, tie breaker open.
            d) Either main-breaker open, tie breaker closed.
   2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:
      a. Transformer kilovolt-ampere and impedances.
      b. Generator impedances.
      c. Generator decrement curves.
      d. Bus withstand ratings.
      e. Cable and bus data.
      f. Protective device taps, time dials, instantaneous pickups, and time delay settings.
   3. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:
      a. Utility tolerances and voltage variations.
   4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.
   5. Obtain equipment layouts and configurations from the manufacturer’s final

submittal requirements and project layout drawings as required.

6. Bus and conductor data:
   a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
   b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.
   c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
   d. Use bus withstand values for all equipment having buses.
   e. Use medium voltage cable reactances based on typical dimensions of shielded cables with 133 percent insulation levels, unless otherwise indicated.
7. Motors:
   a. Each motor shall be individually modeled:
      1) Grouping of motors for fault contribution current is not acceptable.
   b. Motors with variable frequency drives may be assumed to have no contribution to fault current.
8. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.

C. Short-circuit fault analysis study additional requirements:
1. The short-circuit fault analysis shall be performed and submitted in 2 phases:
   a. Initial short-circuit fault analysis:
      1) Based on the Contract Documents and Electric Utility information.
      2) The initial short-circuit fault analysis report shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
      3) Provide a list of assumptions used in the initial study.
   b. Final short-circuit analysis:
      1) The final short-circuit fault analysis shall modify the initial analysis as follows:
         a) Utilize the actual equipment provided on the project.
         b) Utilize conductor lengths based on installation.
2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 and 4 cycle, interrupting symmetrical RMS, and 30 cycle steady state short circuit current values at each piece of equipment in the distribution system.
3. Evaluate bus bracing, short circuit ratings, fuse interrupting capacity and circuit breaker adjusted interrupting capacities against the fault currents, and calculate X/R values:
   a. Identify and document all devices and equipment as either inadequate or acceptable.
4. Calculate line-to-ground and double line-to-ground momentary short circuit values at all buses having ground fault devices.
5. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including Utility X/R ratios, typical values, recommendations, and areas of concern.

D. Protective device coordination study additional requirements:

1. Furnish protective device settings for all functions indicated on the Drawings, including, but not limited to:
   a. Current.
   b. Voltage:
      1) Provide settings for all voltage relays based upon actual Utility and generator tolerances and specifications.
   c. Frequency:
      1) Provide settings for all frequency relays based upon actual Utility and generator tolerances and specifications.
   d. Negative sequence.
   e. Reverse power.
   f. Machine protection functions:
      1) Provide settings for all motor and generator protective relays based on the manufacturer's recommended protection requirements.
2. Provide log-log form time-current curves (TCC's) graphically indicating the coordination proposed for the system:
   a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
      1) Typical time-current curves for identical portions of the system, such as motor circuits, are acceptable as allowed by the ENGINEER.
   b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:
      1) These details can be included on the TCC.
   c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
      1) These details can be included in the TCC.
3. TCC's shall include all equipment in the power distribution system where required to demonstrate coordination. Include Utility relay and fuse characteristics, medium voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:
   a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards and fused disconnect switches.
   b. Provide ground fault TCC's with all adjustable settings for ground fault protective devices.
   c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
   d. On the TCC's show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters and transformer damage curves.
   e. Cable damage curves.
   f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
   g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream device to avoid nuisance tripping.

4. Site Generation: When site generation (including cogeneration, standby, and emergency generators) is part of the electrical system, include phase and ground coordination of the generator protective devices:
   a. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices.
5. Suggest modifications or additions to equipment rating or settings in a tabulated form.

E. Arc-Flash Hazard Study Additional Requirements:
1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
   a. Perform Arc-flash calculations for both the line side and load side of switchgear, motor control center and panelboard main breakers.
   b. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.
   c. Protective device clearing time shall be limited to 2 seconds, maximum.
2. Provide executive summary of the study results.
3. Provide a detailed written discussion and explanation of the tabulated outputs.
4. Provide alternative device settings to allow the OWNER to select the desired functionality of the system:
   a. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.
5. Perform the arc flash study calculations using both IEEE 1584 and NFPA 70E. Provide both studies in the final report. Provide summary based upon worst case results between IEEE 1584 and NFPA 70E.
6. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.
7. Perform arc-flash scenarios at minimum and maximum utility and generator fault contributions.

F. Electrical system study meetings:
1. The individual conducting the short circuit analysis, protective device coordination, and the arc-flash hazard studies shall meet with the OWNER and ENGINEER 3 times.
2. The purpose of the 3 meetings is as follows:
   a. Initial meeting:
      1) Meet with the OWNER and ENGINEER to discuss the scope of the studies.
      2) Discuss the OWNER's operational requirements for both normal operation and maintenance.
   b. Preliminary results meeting:
      1) This meeting will be held after the studies have been completed, reviewed, and accepted by the ENGINEER.
      2) The purpose of this meeting is to inform the OWNER of the results of the study and impacts on normal operation and maintenance including:
         a) Protective device coordination problems and recommended solutions.
         b) Explanation of the arc-flash study results and its potential impact on operations.

c) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.

c. Final meeting:
1) Discuss changes to the reports based on the previous meeting.
2) Discuss with the OWNER how changes to the electrical system may change the arc-flash hazard category.
3) Deliver the final electrical system studies report.

3. The meetings will be at the OWNER's facility:
a. Provide a minimum of 3 weeks' notice to the OWNER and ENGINEER in advance of the projected meeting date.
b. Submit a draft of the meeting agenda when each meeting is requested.

4. Meeting materials:
a. Prepare and provide the following materials:
1) Meeting agenda. Include at a minimum the scope of the meeting, estimated time length for the meeting and meeting goals.
2) 6 copies of the project one-line diagrams for the initial meeting.
3) 6 copies of the studies of the submitted study.

G. By virtue of the fact that this is a professional study the OWNER reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash study shall be modified based on the results of the meetings with the OWNER.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01 33 00 and 26 05 00.

B. Initial Studies and Reports:
1. Include the following in the initial short circuit current report:
a. List of all devices included in the studies.
b. A description of all operating scenarios.
c. Form and format of arc flash labels.

C. Final Studies and Reports:
1. Format and Quantity:
a. Provide 6 bound copies of all final reports.
b. Provide 3 complete sets of electronic files on CD or DVD media, including electrical system model(s), configuration files, custom libraries, any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
c. Provide the number of copies specified in Section 01 33 00.
2. Include the sections below in the final report:
a. Copies of correspondence and data obtained from the Electric Utility Company.
b. Letter certifying the inspection and verification of existing equipment.
c. One-line diagrams:
1) The following information shall be included at a minimum:

a) Motor horsepower.
b) Transformer data:
(1) KVA.
(2) Configuration.
c) Cable Data:
(1) Insulation.
(2) Size.
(3) Length.

2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.

d. Include in the short-circuit fault analysis study:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) Normal system connections and those, which result in maximum fault conditions.
3) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.
4) Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.

e. Protective device coordination study shall include:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) List all requirements used in the selection and setting criteria for any protective devices.
3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
4) Time-current curves (TCC's) graphically indicating the coordination proposed for the system on log-log graphs. At least 3 of the copies shall be in color.
5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.
6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.

f. Include in the arc-flash study:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) Normal system connections and those, which result in maximum arc- flash conditions.
3) Arc-flash raw data, calculations, and assumptions.
4) Arc-flash label data:
a) Identifying the content of each label.
b) Identifying the location of each label.

D. Certification:
1. Submit written certification, sealed, and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.

F. The ENGINEER will review all studies and reports. After review, the ENGINEER will make recommendations and/or require changes to be made to the short-circuit analysis, protective device coordination or arc-flash studies. These changes shall be provided as part of the scope of work.

G. Submit course outline for OWNER'S training.

1.06 QUALITY ASSURANCE

A. Refer to Section 26 05 00.

B. Qualifications of the entity responsible for electrical system studies:
   1. The studies shall be performed, stamped, and signed by a Professional Engineer registered in the state where the project is located.
   2. A minimum of 5 years' experience in power system analysis is required for the individual in responsible charge of the studies.
   3. The short-circuit analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:
      a. Point-to-point calculations are not acceptable.

C. The study shall be performed by an independent firm.

1.07 SEQUENCING

A. Submit the initial short-circuit analysis study before submittal of any electrical equipment.

B. Submit the final short-circuit analysis and protective device coordination studies.

C. First arc-flash meeting.

D. Submit the arc-flash hazard study.

E. Second arc-flash meeting.

F. Third arc-flash meeting and final reports.

G. Label equipment with approved arc flash labels.

H. OWNER's training.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electrical system study software one of the following or equal:
   1. ETAP by Control Technologies.
   2. SKM.

2.02 COMPONENTS

A. Arc-Flash Hazard Labels:
   1. Dimensions:
      a. Minimum 5 inches by 3.5 inches.
   2. Materials:
      a. Polyester with polyvinyl polymer over-laminate.
      b. Self-adhesive.
      c. Resistant to:
         1) UV.
         2) Chemicals and common cleaning solvent resistant.
         3) Scuffing.
         4) Wide temperature changes.
   3. Contents:
      a. Short-circuit bus identification.
      b. Calculated incident energy (calories/square centimeter) range.
      c. Hazard/risk, personnel protective equipment category number.
      d. Arc-flash protection boundary.
      e. Shock Hazard Boundary:
         1) The CONTACTOR may provide separate labels for indication of the shock hazard boundary.
      f. Description of the combined level of personnel protective equipment.
   4. Color Scheme:
      a. For locations above 40 calories/square centimeter:
         1) White label with red “DANGER” strip across the top.
         2) Black lettering.
      b. For locations below 40 calories/square centimeter:
         1) White label with orange “WARNING” strip across the top.
         2) Black lettering.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Section 26 05 00.

B. After review and acceptance of the arc-flash hazard study by the ENGINEER, install all arc-flash hazard labels:
   1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.
   2. At a minimum install labels in the following locations:
      a. The front of each main or incoming service compartment.
      b. The front of each low voltage switchgear section.
      c. The front of each medium voltage circuit breaker door.
      d. The front of each accessible auxiliary or conductor compartment.

e. Each accessible rear or side vertical section.
f. Each motor control center compartment.
g. Each panelboard covered by the study.
h. Each control panel, individual starter or VFD or other equipment covered by the scope of the study.

3. Install labels prior to equipment energization.

C. After review and acceptance of the arc-flash hazard study and coordination study by the ENGINEER, adjust protective device settings per final study prior to equipment energization.
1. Devices which require power for configuration may be set during energization, but before any subfed loads are energized.
2. Ensure that settings for upstream, existing equipment are set prior to energizing new downstream devices.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 26 05 00.

B. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:
1. Remove and replace any improperly applied labels.
2. Repair the equipment finish damaged by removal of any label.
3. Install labels to within 1/64 inch of level or plumb across the entire dimension of the label.

3.03 ADJUSTING

A. After review and acceptance of the recommended settings in the Protective Device Coordination Study, make settings in accordance with the manufacturer's instructions.

3.04 DEMONSTRATION AND TRAINING

A. Refer to Section 26 05 00.

B. Training:
1. Provide a minimum of 2 training sessions for the OWNER's electrical maintenance personnel:
a. Each session shall be a minimum of 4 hours.
2. The training shall cover at a minimum:
a. Hazards associated with arc-flash.
b. Causes of arc-flash.
c. Explanation of the arc-flash labels installed on the OWNER's electrical equipment.
d. Proper use of personal protective equipment.
e. Personal protective equipment requirements for maintenance work.
3. The individual in charge of the arc-flash study or qualified representative shall conduct the training sessions.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 -– GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to non-networked lighting control devices.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
   a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. NEMA –National Electrical Manufacturer’s Association
   a. ICS 1; Industrial Control and Systems: General Requirements
   b. ICS 6; Industrial Control and Systems: Enclosures
3. UL -Underwriters Laboratories, Inc.
   a. 50; Cabinets and Boxes
   b. 508; Standard for Industrial Control Equipment
   c. 773A; Standard for Nonindustrial Photoelectric Switches for Lighting Control
   d. 916; Standard for Energy Management Equipment

1.03 SYSTEM DESCRIPTION

A. Lighting Control Devices

1. Devices include occupancy sensors and automatic time clock line voltage devices.

1.04 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Operating, maintenance and instruction manuals shall be furnished in accordance with General Conditions and Section 26 05 00.

C. Operating instruction manuals outlining the step-by-step procedures required for system start-up and operation shall be furnished. The instructions shall include manufacturer's name, model number, service manual parts list, and brief description of all equipment and their basic operating features.

D. Maintenance instruction manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdowns and repairs and a simplified connection wiring diagram for the system as installed.

1.05 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

1.06 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

1.07 WARRANTY

A. Furnish guarantee in accordance with and in form required under Section 26 05 00.

1.08 SYSTEM STARTUP

A. Refer to manufacturer's documentation to start-up procedures and requirements.

PART 2 -PRODUCTS

2.01 LIGHTING CONTROL DEVICES

A. General

1. Dual voltage rated for 120 and 277Vac.

2. Compatible with all electronic ballasts, incandescent and motor rated type loads.
3. Utilizes advance electronic circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
4. All devices shall have a LED or LCD indicating light.
5. All switches shall fit behind a decorator style faceplate.

B. Occupancy Wall Switches

1. Digital Time Wall Switch
   a. Manufacturers
      1) Hubbell TD200, WattStopper TS-400 or approved equal.
   b. General
      1) The digital time switch shall be programmable to turn lights off after a preset time and capable of operating as an ON/OFF switch.
      2) Time switch shall have no minimum load requirement and shall be capable of controlling 800W at 100/120Vac, 1,200W at 230/277Vac, and 1/6 hp at 125Vac.
      3) Time scroll feature shall allow manual overriding of the preset time-out period.
      4) Time switch shall have the option for audible and visual alerts 1 minute prior to timeout.
      5) Time switch shall have an LCD that shows the timer's countdown.
      6) Time-out period shall be adjustable in settings of
         a) 5, 15, and 30 minutes.
         b) 1, 3, 6, 9, and 12 hours.
2. Multi-Technology Wall Switch (Infrared and Ultrasonic Technologies)
   a. Manufacturers
      1) Hubbell LHMT or approved equal (no known equal).
   b. General
      1) The passive adaptive infrared and ultrasonic wall switch sensor shall be a self-contained control system that replaces a standard toggle switch.
      2) Microprocessor technology shall be utilized to avoid false ON activations and to provide high sensitivity to minor occupant motion by detecting infrared energy changes and doppler shifts in transmitted ultrasound within the controlled space.
      3) Infrared sensor shall utilize a temperature compensated, dual element sensor and a multi-element fresnel lens.
      4) Ultrasonic senor shall utilize a 40kHz signal.

5) Sensor shall cover up to 1,000SF for walking motion, with a field of view of 180 degrees.

6) Sensor shall be capable of controlling 600W at 100/120Vac and 1,200W at 230/277Vac electronic ballasts and incandescent loads.

7) Sensor shall have a built-in adjustable light level feature that holds load off when a desired footcandle level is present.

8) Sensor shall timeout at 8 minutes initially and will self-adjust based on occupancy.

3. Multi-Technology, Dual Circuit Wall Switch (Infrared and Ultrasonic Technologies)

a. Manufacturers

1) Hubbell LHMTD2 or approved equal (no known equal).

b. General

1) Same as the Multi-Technology Wall Switch above, but with dual input, independent circuit switching capability.

4. Automatic Wall Switch (Infrared Technology)

a. Manufacturers

1) Hubbell WS1200AT, WattStopper WS-200 or approved equal.

b. General

1) The passive adaptive infrared wall switch sensor shall be a self-contained control system that replaces a standard toggle switch.

2) Microprocessor technology shall be utilized to avoid false ON activations and to provide high sensitivity to minor occupant motion by detecting infrared energy changes within the controlled space.

3) Sensor shall utilize a temperature compensated, dual element sensor and a multi-element fresnel lens.

4) Sensor shall cover up to 900SF for walking motion, with a field of view of 180 degrees.

5) Sensor shall have no minimum load requirement and shall be capable of controlling 800W at 100/120Vac and 1,200W at 230/277Vac electronic ballasts and incandescent loads.

6) Sensor shall have a built-in adjustable light level feature that holds load off when a desired footcandle level is present.

7) Sensor shall have a time delay adjustable from 5 to 30 minutes.

C. Ceiling and Wall Mounted Sensors

1. General

1) Microprocessor technology shall be utilized to avoid false ON activations and to provide high sensitivity to minor occupant

motion by detecting changes in sensor readings within the controlled space.

2) The sensor shall have a single pole, double throw isolated relay rated for 1.0A at 24Vdc.

3) Sensor shall have a built-in adjustable light level feature that holds load off when a desired footcandle level is present.

4) For accuracy and consistency, sensor shall have a controlled, digital time delay adjustable from 8 to 30 minutes.

5) Provide power packs for sensors as required with the following characteristics:

a) For ease and speed of installation, power and auxiliary relay pack shall have 1/2" snap-in nipple for 1/2" knockouts and mounting on outside of enclosure.

b) Power and auxiliary relay packs shall have dry contacts capable of switching 20A ballast 120/277Vac load, 13A incandescent, 1 hp at 120/240Vac

c) Power packs shall use 120Vac or 277Vac input and provide a 24Vdc, 100mA output.

d) Auxiliary relay packs shall be identical in physical size of power packs and contain no transformer power supply and shall have similar rated contacts.

e) Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.

f) Power and auxiliary relay packs shall have low voltage teflon coated leads, rated for 300V, suitable for use in plenum applications.

2. Infrared Sensor

a. Manufacturers

1) Ceiling Only Mount: Hubbell OMNI-IR-RP series, WattStopper CI series or approved equal.

2) Wall Mount: Hubbell LO-DIA-RP, WattStopper CX series or approved equal.

b. General

1) The passive infrared sensor shall be capable of detecting presence in the control area by changes in the infrared energy.

2) Sensor shall utilize a temperature compensated dual element sensor and a multi-element fresnel lens.

3) Sensor with a 120” mounting height shall have the following typical coverage zones:

a) Ceiling only mounts: 450 SF or 1,500SF areas at 360 degrees.

b) Wall/ceiling mounts: 1,600SF area at 110 degrees.

3. Ultrasonic Sensor
   a. Manufacturers
      1) Hubbell OMNI-US-RP series, WattStopper WT series or approved equal.
   b. General
      1) The ultrasonic sensor shall be capable of detecting presence in the control area by doppler shifts in transmitted ultrasound within the controlled space.
      2) Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to assure compatibility in the event more sensors are added.
      3) Sensor with a 120” mounting height shall have the following minimum rectangular coverage zones:
         a) 500 SF at 180 degrees
         b) 1,000SF or 2,000SF areas at 360 degrees.
4. Dual Technology Sensor (Infrared and Ultrasonic Technologies)
   a. Manufacturers
      1) Hubbell LO-DT-RP or OMNI-DT-RP series, WattStopper DT series or approved equal.
   b. General
      1) The passive adaptive infrared and ultrasonic sensor shall be capable of detecting presence in the control area by changes in the infrared energy and doppler shifts in transmitted ultrasound within the controlled space.
      2) Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to assure compatibility in the event more sensors are added.
      3) Sensor shall utilize a temperature compensated dual element sensor and a multi-element fresnel lens.
      4) Ceiling sensors with a 120” mounting height shall have the following minimum coverage zones:
         a) 500 SF at 180 degrees
         b) 1,000SF or 2,000SF areas at 360 degrees.
      5) Wall sensor with a 120” mounting height shall have a 1,600SF minimum coverage area at nearly 180 degrees.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Work shall be installed as shown on the Drawings in accordance with the manufacturer's diagrams and recommendations, except where otherwise indicated.

B. Contractor shall provide initial setup and programming for all devices and software installed under this Section for a complete and operational system. System interfaces shall be coordinated with Owner, where appropriate.

C. All cable runs shall comply with the requirements of this Division and manufacturer's specifications and shall be continuous between devices and equipment. All control cabling shall meet CEC/NEC 725 or 800 as required and be UL listed for its application.

D. Set sensor's time delays and sensitivity adjustments in accordance to manufacturer's guidelines and Owner's direction.

E. Provide appropriate power pack for each ceiling or wall mounted occupancy sensor, whether shown or not on Drawings, unless otherwise noted.

F. Where drawings indicate slave sensors provide necessary raceway and cabling to connect sensor such that input from either master or slave sensor will activate load.

G. Locate photoelectric switches (photocell), when required, at one of the following locations with a northern or western exposure:

1. Route ½" conduit to roof and penetrate deck and locate +18" above finish floor. Seal penetration per Specifications.

2. Route ½" conduit to nearest service or support exterior doorway and mount +8" above door frame in a flush weatherproof outlet box.

H. Orient photocell toward north. If northern orientation cannot be obtained, orient the device west.

I. Provide the following items for a complete and operational low voltage lighting control system as required by the manufacturer's specifications:

1. Auxiliary cabinets and boxes for all modules and devices not mounted within relay panel.

2. Install network modules and repeaters necessary to extend the dataline to all modules and devices within the network as required by manufacturer's specifications.

3. Provide ADIMs of sufficient quantities to connect all analog devices shown on Drawings.

4. Coordinate interface with BMS/BAS with other trades and vendors to provide functionality contained herein (i.e., time clock scheduling and relay status).

5. All low voltage cables between system components, sensors and input devices shall meet manufacturer's specifications.

J. Contractor shall coordinate programming of time clock schedules and relay groups not shown in Drawings with Owner.

3.02 FIELD QUALITY CONTROL

A. The Contractor shall demonstrate the system functionality to manufacturer's specifications and requirements after completion of installation.

B. The Engineer or Owner may order any changes, adjustments or further tests deemed necessary to assure that the system and its components are complete and operational in accordance with the Specifications.

3.03 ADJUSTING

A. After 60 days of Owner occupancy provide labor to adjust time delays and sensitivity adjustments on each occupancy and photocell sensor.

3.04 DEMONSTRATION

A. The Contractor shall properly instruct the Owner to the operational procedures of the system.

B. Within the first 30 days from system startup, the equipment supplier shall provide no less than four (4) hours for instruction and training.

END OF SECTION

SECTION 26 18 11

OVERCURRENT PROTECTION DEVICES

PART 1 -- GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to overcurrent protection devices.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
   a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
   a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit And Service
3. NEMA –National Electrical Manufacturer’s Association
   a. AB 1; Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
   b. PB 2.2; Application Guide for Ground Fault Protective Devices for Equipment
4. UL -Underwriters Laboratories, Inc.
   a. 248; Low Voltage Fuses
   b. 468; Wire Connectors
   c. 508E; IEC Type "2" Coordination Short Circuit Tests
   d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
   e. 943; Standard for Ground-Fault Circuit-Interrupters

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Production test of circuit breakers upon request of Engineer.

C. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.

1.05 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

PART 2 - PRODUCTS

2.01 FUSES

A. All power distribution fuses shall be time-delay, high interrupting (200kAIC minimum) and current limiting type, unless otherwise indicated. All fuses shall be of same manufacturer and model.

1. Motor branch circuit fuses (0 – 600A): UL Class RK5 dual element, time delay type shall be size for UL 508E "Type 2" coordination for the motor controller. Coordinate fuse selection with motor starter overload relay heaters as required.

2. General purpose feeder fuses (0 – 600A): UL Class RK1 dual element, time delay type shall be size per Drawings.

B. Control and instrumentation fuses shall of type and rating as recommended by equipment manufacturer, suitable for fuse blocks or holders installation.

2.02 MOLDED CASE CIRCUIT BREAKERS

A. General

1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.

3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication.

4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker after installation.
5. Circuit breakers shall have an RMS interrupting capacity not less than shown on Drawings, or if not shown shall not be less than:
    a. 25kA for 480V systems
    b. 22kA for 240V (or less) systems
6. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
7. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on Drawing. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
8. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
9. Circuit breakers shall be constructed with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs. Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the CEC.
10. All circuit breakers shall be capable of accepting bus connections.

B. Thermal-Magnetic Circuit Breakers
    1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
    2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.
    3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker.
    4. Provide equipment ground fault protection where shown on Drawing with the following features.
        a. Ground fault sensing system shall be modified zero sequence sensing type and not require any external power to trip the circuit breaker.
        b. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
        c. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.

d. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.

e. A means of testing the ground fault system to meet the on-site testing requirements of CEC 230.95 (C) shall be provided.

f. Local visual ground fault trip indication shall be provided.

g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

C. Electronic Trip Circuit Breakers

1. Circuit breaker trip system shall be a microprocessor-based true RMS sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on Drawings.

2. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.

3. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 80% (or 100% where noted on Drawings) of their ampere rating continuously.

4. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.

   a. Instantaneous Pickup

   b. Long Time Pickup

   c. Long Time Delay

   d. Short Time Pickup

   e. Short Time Delay

   f. Ground Fault Pickup (when specified with ground fault protection)

   g. Ground Fault Delay (when specified with ground fault protection)

5. A means to seal the trip unit adjustments in accordance with CEC 240.6 (B) shall be provided.

6. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.

7. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. All current values shall be displayed in true RMS with 2% accuracy.

8. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.

9. The trip system shall include a Long Time memory circuit to sum the time increments of intermittent overcurrent conditions above the pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
10. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in true RMS with 2% accuracy.
11. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
12. Equipment Ground Fault Protection shall be provided where noted on Drawings.
    a. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
    b. A separate neutral current transformer shall be provided for three-phase, four-wire systems.
    c. Ground fault sensing system shall be residual sensing type.
    d. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
    e. A means of testing the ground fault system to meet the on-site testing requirements of CEC 230.95 (C) shall be provided.
    f. Local visual trip indication for a ground fault trip occurrence shall be provided.
    g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.
13. Circuit breaker trip system shall be equipped with an externally accessible test port. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.

PART 3 -EXECUTION

3.01 PREPARATION

A. Notify Engineer no later than 10 working days for adjustable circuit breaker settings not shown within Drawings. Submit to Engineer the following information:
    1. Panel, switchboard name/ID
    2. Circuit breaker identifier (i.e., main circuit breaker, load served, etc.)
    3. List of necessary settings (i.e., trip settings, time delays, etc.)

3.02 INSTALLATION

A. Install equipment and their accessories in to manufacturer's instructions, pertinent Codes, and with recognized industry practices to insure device operates properly.

B. Tighten electrical connectors and terminals in accordance to manufacturer's requirements. Where the manufacturer does not have published torque tightening values, comply with the requirements of UL 468.

3.03 FIELD QUALITY CONTROL

A. Check tightness of circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

B. Contractor to obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests for

1. Check each circuit breaker above 100A on a 225A frame for long-time and short-time delay pickup and instantaneous pickup.

   a. Instantaneous pickup current shall be determined by 4 cycles or less.

   b. b. Perform timing test with 300% of breaker trip unit rated current.

   c. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.

2. Test and calibrate ground fault protection trip and pickup time on 225A frame breakers and larger.

C. Physically test key interlock systems to check for proper functionality.

D. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

3.04 ADJUSTING

A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.

B. Adjust circuit breaker trip and time delay settings to values indicated as instructed by Engineer.

1. Check each circuit breaker above 100A, long-time and short-time delay pickup and instantaneous pickup. Instantaneous pickup current shall be determined by 4 cycles or less. Perform timing test with 300% of breaker trip unit rated current. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.

2. Main circuit breaker ground fault setting shall be per CEC 230.95 (A) or as directed by Engineer.

3.05 PROTECTION

A. When directed by Engineer provide physical means to "permanently fix" settings for rotary and DIP type switches with a thin coat of clear lacquer.

3.06 CLEANING

A. Remove marks, dirt and debris from installed equipment surfaces for “new like” appearance.

END OF SECTION

SECTION 26 22 00

LOW VOLTAGE TRANSFORMER – DRY TYPE (600VAC AND LESS)

PART 1 -GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to transformers.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI - American National Standards Institute
    a. C57; Distribution and Power Transformers, Guide for Loading Dry-Type
2. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. NECA –National Electrical Contractors Association
    a. 409; Recommended Practices for Installing and Maintaining Dry-Type Transformers
4. NEMA –National Electrical Manufacturer's Association
    a. ST20; Dry Type Transformers for General Applications
    b. TP1; Guide for Determining Energy Efficiency for Distribution Transformers
    c. TP2; Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
    d. TP3; Standard for the Labeling of Distribution Transformer Efficiency
    e. TR1; Transformers, Regulators, and Reactors

5. UL -Underwriters Laboratories, Inc.
    a. 1561; Dry-Type General Purpose and Power Transformers

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Include outline and support point dimensions of enclosures and accessories; unit weights; voltage; kVA rating; impedance rating and characteristics; loss and efficiency data at 25%, 50%, 75% and 100% rated load; sound level, tap configurations; insulation system type; and rated temperature raised

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. Installation shall conform to NECA 409-2002, Recommended Practice for Installing and Maintaining Dry-Type Transformers.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store in a warm, dry location with uniform temperature. Protect unit if handled in inclement weather (i.e., rain, sleet, snow, etc.). Cover ventilating opening to keep out dust and foreign materials prior to startup.

B. Handle transformer using only lifting eyes and brackets provided for that purpose; see manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL PURPOSE

A. Manufacturers
    1. Square D, Cutler-Hammer or approved equal.

B. Rating Information
    1. All insulating materials are to exceed NEMA ST20 standards and be rated for 220°C UL component recognized insulation system.
    2. Capable of meeting daily overload requirements of ANSI C57.96.
    3. Transformers 15kVA and larger shall be 150°C temperature rise above 40°C ambient. Transformers 25kVA and larger shall have a minimum of 4 - 2.5% full capacity primary taps.
    4. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
    5. Sound levels shall be warranted by the manufacturer not to exceed NEMA ST20 requirements.

C. Construction

1. Transformer coils shall be of the continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.
2. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating. Cores for transformers greater than 500kVA shall be clamped utilizing insulated bolts through the core laminations to ensure proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.
3. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and CEC standards.
4. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use.
5. Manufacturer shall provide the optional accessories where required and noted on the Drawings:
    a. Weathershields for all models.
    b. Wall mounting brackets for 75kVA units and smaller.
    c. Ceiling mounting brackets for 150kVA units and smaller.

2.02 ENERGY EFFICIENT, GENERAL PURPOSE

A. Manufacturers
    1. Square D, Cutler-Hammer or approved equal.
B. Rating Information
    1. Same as General Purpose above except:
        a. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.
C. Construction
    1. Same as General Purpose above.

2.03 PREMIUM GRADE

A. Manufacturers
    1. Square D, Cutler-Hammer or approved equal.

2.04 B. RATING INFORMATION

1. Same as General Purpose above except:
    a. Transformers 10kVA and larger shall have the following temperature rise above 40°C ambient capable of maintaining a continuous load without exceeding a 150°C rise in a 40°C ambient:
        1) 115°C rise with 115% rated load.
        2) 80°C rise with 130% rated load.
    b. The maximum temperature of the top of the enclosure shall not exceed 35°C rise above a 40°C ambient.

B. Construction
1. Same as General Purpose above.

2.05 NON-LINEAR

A. Manufacturers
1. Square D, Cutler-Hammer or approved equal.

B. Rating Information
1. Same as General Purpose above except:
    a. Neither the primary nor the secondary temperature shall exceed 220°C at any point in the coils while carrying their full rating of non-sinusoidal load. Transformers are to be UL listed and as defined as the sum of fundamental and harmonic Ih(pu)2h2 per UL 1561. Transformers evaluated by the UL K-Factor evaluation shall be listed for either 115°C or 80°C average temperature rise as noted on the Drawings. K-Factor listed transformers rated at 150°C rise shall not be acceptable.
    b. K-Factor rated transformers shall have an impedance range of 3% to 5%, and shall have a minimum reactance of 2% in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.

C. Construction
1. Same as General Purpose above except:
    a. Transformers shall be supplied with quality, full width electrostatic shields resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
        1) Common Mode: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB
        2) Transverse Mode: 1.5kHz to 10kHz - 52dB; 10kHz to 100kHz - 30dB; 100kHz to 1MHz - 30dB

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine transformer to provide adequate clearances for installation.

B. Check that concrete pads are level and free of irregularities for floor mounted installations.

C. Begin work only after unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Read and follow manufacturer's bulletin included with unit prior to installation.

B. Installation shall conform to NECA 409 where not specified under this Section.

C. Transformers not specifically designed for wall mounting, shall be spaced a minimum of 6" from adjacent walls, ceiling and all other equipment.

D. Mount to resist seismic forces and brace to 0.56g. Submit calculations and mounting details for review and approval.

E. Terminations

1. Provide all transformers with lugs for both primary and secondary conductors shown on Drawings. Connect lug to termination point with appropriate size bolt, nut and washers.

2. Use flexible conduit indoors in dry locations or liquidtight flexible conduit in damp/wet locations for primary and secondary connections to transformer case when less than 48" in length. Connection shall be to enclosure's side panels only unless fed directly below from ground mounted installation or as shown on Drawings.

F. Grounding

1. Provide a dual rated four-barrel solderless grounding lug with a 5/8"-11 threaded hole. Drill transformer enclosure with 11/16" bit and attach lug to enclosure using a torque bolt and T&B Dragon Tooth transition washer with the following connections:

a. Primary feeder ground

b. Secondary feeder ground

c. Grounding electrode per CEC 250.30.

d. Main bond jumper to neutral (when present)

3.03 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages, and make appropriate tap adjustments to within 2% of rated voltage

3.04 CLEANING

A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 -GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to switchboards and large distribution panels.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
    b. 26 24 19 – Motor Control Centers
    c. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI - American National Standards Institute
    a. C12.16; Solid State Electricity Metering
    b. C57.13; Instrument Transformers
2. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. Federal Specification
    a. W-C-37; Circuit Breakers, Molded Case, Branch Circuit And Service
4. NECA –National Electrical Contractors Association
    a. 400, Recommended Practice for Installing and Maintaining Switchboards
5. NEMA –National Electrical Manufacturer’s Association
    a. AB 1; Molded Case Circuit Breakers and Molded Case Switches
    b. KS; Fused and Non-fused Switches

c. PB 2; Deadfront Distribution Switchboards, File E8681

d. PB 2.1; Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less

e. PB 2.2; Application Guide for Ground Fault Protective Devices for Equipment

6. UL -Underwriters Laboratories, Inc.

a. UL 50; Cabinets and Boxes

b. UL 98; Enclosed and Dead Front Switches

c. UL 489; Molded Case Circuit Breakers

d. UL 891; Dead-Front Switchboards

e. UL 943; Ground Fault Circuit Interrupters

f. UL 977; Fused Power Circuit Devices

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and switchboard instrument details.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.

C. Installation shall conform to NECA 400. Recommended Practice for Installing and Maintaining Switchboards unless otherwise specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

B. Each switchboard section shall be delivered in individual shipping splits for ease of handling. They shall be individually wrapped for protection and mounted on shipping skids.

C. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

D. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Square D or approved equal.

B. Shall match the manufacturer for Section 26 24 19.

2.02 MATERIAL

A. General

1. Utility Metering Compartment: The utility current transformer compartment shall be connected for hot sequence metering. The compartment shall comply with EUSERC and/or the local utility company specifications.
2. Switchboards shall be rated with a minimum short circuit current rating at listed voltage as shown on Drawings.
3. All unused spaces provided, unless otherwise specified, shall be fully bussed and equipped for future devices, including all appropriate connectors and mounting hardware.
4. Enclosure shall be of NEMA type shown on Drawings.
5. Sections shall be aligned front and rear.
6. The switchboard(s) shall be of deadfront construction.
7. The switchboard frame shall be of formed steel rigidly bolted together to support all cover plates, bussing and component devices during shipment and installation.
8. Each switchboard section shall have an open bottom and an individually removable top plate for installation and termination of conduit.
9. The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be a medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
10. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
11. Top and bottom conduit areas shall be clearly indicated on shop drawings.
12. Provide 1” high by 3” wide engraved laminated nameplates for each device. Furnish black letters on a white background for all voltages.
13. Bus Composition shall be plated copper. Plating shall be applied continuously to all bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet UL 891 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown in the plans. For 4-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not acceptable. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions.
14. Bus Connections shall be bolted with Grade 5 bolts and conical spring washers.
15. Ground Bus shall be sized per CEC and UL 891 Tables 25.1 and 25.2 and shall extend the entire length of the switchboard. Provisions for the addition of future sections shall be provided.

16. Square-D I-Line or equivalent distribution bussing with the following characteristics where so noted on Drawings.
    a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly, facilitating ease of installation of future devices.
    b. The interior shall have three bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus., providing side-by-side mounting of breakers.
    c. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
    d. Line-side circuit breaker connections are to be jaw type, whereby clamping forces are increased under faulted conditions.
    e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

B. Incoming main devices shall of type and accessories as shown on Drawings.
    1. Circuit Breakers
        a. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.
    2. Fusible Switches
        a. Single main group mounted through 800 A.
        b. Fusible main switch shall be group mounted plug-on with mechanical restraint. No additional hardware shall be required to mount the fusible switch into the switchboard.
        c. Switch shall have dual cover interlocks designed to prevent the opening of the cover when the switch is ON. The cover interlock shall prevent the switch from being turned ON with the cover open. Interlock may be manually overridden for testing purposes. Switch cover shall include a means by which the cover can be padlocked in the closed position. The operating handle shall feature positive lock-off means by providing provisions for (3) 0.375” padlocks.
        d. Load side fusible switch connections shall be jaw type.
    3. Incoming Lug Only (Distribution only, non-service entrance)
        a. Incoming conductors shall terminate at lug landing pads rated per Drawings.
        b. All lugs shall be UL Listed to accept solid and/or stranded copper conductors only. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the CEC.
        c. Provide compression type lugs to accommodate the conductor shown on the associated drawings.

C. Distribution section devices shall of type and accessories as shown on Drawings.

1. Group mounted or individually mounted as shown on Drawings.
2. All distribution circuit breakers shall be thermal-magnetic molded case, unless otherwise noted on Drawings.
3. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine switchboard to provide adequate clearances for installation.

B. Check that concrete pads are level and free of irregularities.

C. Begin work only after unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install switchboard in location shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1. Anchor to resist seismic forces as indicated on Drawings and in accordance with California Building Code (CBC) anchorage requirements. Provide all testing and inspections requirements by inspecting authority.

B. Installation shall conform to NECA 400 where not specified under this Section.

C. Tighten accessible bus connection and mechanical fasteners after placing switchboard.

3.03 FIELD QUALITY CONTROL

A. Contractor shall obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests.

B. Inspect complete installation for physical damage, proper alignment, anchorage and grounding prior to energizing.

C. Measure the insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each at 1000Vdc; acceptable insulation resistance is 1 megaohms. Also, refer to manufacturer's specifications for specific testing procedures and values.

D. Check tightness of accessible bolted bus joints using a calibrated torque wrench per manufacturer's specifications.

E. Physically test key interlock systems to check for proper functionality.

F. Test ground fault systems by push-to-test button.

G. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

3.04 ADJUSTING

A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.

B. Tighten bolted bus connections in accordance with manufacturer's instructions.

C. Adjust circuit breaker trip and time delay settings to values indicated by Engineer.

D. Main circuit breaker ground fault setting shall be per CEC 230-95 (A).

3.05 CLEANING

A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 -GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to panelboards.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
    b. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
    a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit And Service
3. NECA –National Electrical Contractors Association
    a. 407, Recommended Practice for Installing and Maintaining Panelboards
4. NEMA –National Electrical Manufacturer’s Association
    a. AB 1; Molded Case Circuit Breakers
    b. PB 1; Panelboards
    c. PB 1.1; Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
5. UL -Underwriters Laboratories, Inc.
    a. 50; Cabinets and Boxes

b. 67; Panelboards

c. 98; Enclosed and Dead Front Switches

d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures

e. 891; Dead-Front Switchboards

f. 943; Ground Fault Circuit Interrupters

g. 977; Fused Power Circuit Devices50; Enclosures for Electrical Equipment

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

1.05 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Square D, Cutler-Hammer or approved equal.

2.02 MATERIALS

A. Panelboards

1. Interior

a. Shall be factory-assembled with voltage, ampacity, and short circuit rating as shown in Drawings.

b. Provide 1 continuous copper bus bar per phase. Each bus bar shall have sequentially phase branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and CEC 230.F and 230.G.

c. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength material.

d. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trims shall have pre-formed twist-out covering unused mounting spaces.

e. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior.

f. Main and sub-feed circuit breakers shall be vertical mounted. Interior leveling provisions shall be provided for flush mounted applications.

2. Main Circuit Breaker

   a. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.

3. Branch Circuit Breakers

   a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.

4. Enclosures

   a. Type NEMA 1 Boxes

      1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvanealed steel will not be acceptable.

      2) Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.

      3) Box width shall be 20 in wide.

   b. Type NEMA 1 Fronts

      1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

      2) Fronts shall be hinged 1-piece with door. Mounting shall be as indicated in Drawings.

      3) Panelboards rated 225 amperes and below shall flat fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 225 amperes shall have fronts with trim clamps and concealed door hinges. Front doors shall have rounded corners and edges shall be free of burrs.

      4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless-steel door pull. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

   c. Type NEMA 3R, 5, and 12

1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
2) All doors shall be gasketed and equipped with a tumbler type vault lock. All lock assemblies shall be keyed alike. 2 keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
3) Maximum enclosure dimensions shall not exceed 20 in wide and 6.5 in deep.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and NEMA PB 1.1.

B. Installation shall conform to NECA 407 where not specified under this Section.

C. Anchor panelboards to structural members and as shown on Drawings. Provide additional support as required. Anchor freestanding distribution panels to concrete pad.

D. Mount panelboards level and plumb.

E. Install flush mounted panel backbox front edges flush with finished wall. Where flush panel backbox is deeper than wall depth, install closing trim of wood or metal to provide a finished trim.

F. Where panelboard is flush in wall, provide one ¾" conduit stub into accessible ceiling above for every 5 spare circuit breaker or available space.

G. After installation, make all feeder connections to circuit breaker load side lugs and incoming secondary feeders.

3.02 FIELD QUALITY CONTROL

A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.

B. Check tightness of bolted connections and circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 ADJUSTING

A. Measure steady state load line currents at each panelboard feeder; rearrange panelboard circuits to balance the phase loads with 20% of each other. Maintain proper phasing for multi-wire branch circuits.

B. Fill out panelboard circuit identification card, typewritten, with list of circuits in use. Identification shall be specific with room designation and other information as necessary. For distribution panels, use engraved laminated phenolic plates showing load served.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to motor control centers (MCC).

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 40 50 00 – Instrumentation and Controls – General Provisions
    b. 40 51 50 – Control Panels and Panel Mounted Equipment
    c. 26 05 26 – Grounding and Bonding for Electrical Systems
    d. 26 29 23 – Variable Frequency Drives
    e. 26 18 11 – Overcurrent Protection Devices
    f. 26 24 16 – Panelboards
    g. 26 22 00 – Distribution Dry-Type Transformers
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
    a. W-C-37; Circuit Breakers, Molded Case, Branch Circuit And Service
3. NECA –National Electrical Contractors Association
    a. 402, Recommended Practice for Installing and Maintaining Motor Control Centers
4. NEMA –National Electrical Manufacturer’s Association
    a. AB 1; Molded Case Circuit Breakers and Molded Case Switches

b. ICS 1; Industrial Control and Systems: General Requirements

c. ICS 2; Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts

d. KS; Fused and Non-fused Switches

5. UL -Underwriters Laboratories, Inc.

a. UL 489; Molded Case Circuit Breakers

b. UL 845; Motor Control Centers

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and switchboard instrument details.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9001 Series Standards for quality.

C. The manufacturer of the MCC shall possess the following certifications:

1. A member of Control System Integrators Association (CSIA) and hold the title of CSIA Certified Integrator.

2. A member of Underwriters Lab or other nationally recognized testing company.

D. Installation shall conform to NECA 402, Recommended Practice for Installing and Maintaining Motor Control Centers unless otherwise specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

B. Each switchboard section shall be delivered in individual shipping splits for ease of handling. They shall be individually wrapped for protection and mounted on shipping skids.

C. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

D. Handle in accordance with manufacturer's written instructions. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Square D Model 6 or approved equal.

2.02 RATINGS

A. Voltage - Unless shown differently on the drawings, the MCC shall be rated for a 480V system.

B. Short Circuit Withstand Rating – Unless shown differently on the drawings, the MCC shall be rated for a fault current of 42,000A.

2.03 ENCLOSURE

A. The MCC shall be NEMA Type 12 unless otherwise indicated in the Drawings.

B. Removable end plates on each end of the MCC shall cover the horizontal bus and horizontal wireway openings.

C. The MCC shall include bottom plates.

D. Each section shall be equipped with full metal side sheets to isolate each vertical section.

E. All interior and exterior surfaces shall be painted ANSI 49 medium light gray. The vertical wireways and unit back plates shall be painted high visibility gloss white.

F. All unpainted parts shall be plated for corrosion resistance.

2.04 STRUCTURE

A. Motor control centers (MCC) shall be made up of standardized, freestanding modular sections.

B. The MCC shall be of dead front construction and shall consist of one or more vertical sections bolted together to form a rigid, free-standing assembly. The systems shall be designed to allow for the addition of future sections and to permit the interchanging of units. The overall length of the MCC shall not exceed the dimensions shown on the Drawings.

C. All louvers and vents shall be screened and supplied with replaceable filters.

D. Vertical sections shall be rigid, free-standing structures.

1. Vertical sections shall have internal mounting angles running continuously within the shipping block.

2. Vertical sections shall be 90 inches high, 20 inches deep and 20 inches wide except where larger dimensions are required.

3. Vertical sections shall be provided with a removable steel lifting angle on all shipping blocks. The angle shall run the length of the shipping block.

E. Provide full depth horizontal wireways at the top and bottom of the MCC.

1. The horizontal wireways shall be isolated from the bus.

2. The horizontal wireways shall have removable covers held in place by captive screws.

F. Provide a full height vertical wireway, independent of the plug-in units, in each standard vertical section.

1. The vertical wireway shall be isolated from the vertical and horizontal buses.
2. The vertical wireway shall be covered with a hinged and secured door.
3. Wireway tie bars shall be provided.
4. Isolation between the wireway and units shall be provided.

2.05 COMPONENTS

A. Miscellaneous Information

1. Handle

a. Units shall be provided with a heavy-duty, industrial, flange mounted handle mechanism for control of each disconnect switch or circuit breaker.

b. The operator units may pivot in the vertical or horizontal plane.

c. The on-off condition shall be indicated by the handle position, red and green color indicators with the words ON and OFF, and the international symbols I and O along with a pictorial indication of the handle position.

d. Handles shall be capable of being locked in the OFF position with up to three padlocks.

e. The operator handle shall be interlocked with the unit door so that the disconnect cannot be switched to the ON position unless the unit door is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing.

f. The operator handle shall be interlocked with the unit so that the unit cannot be inserted or withdrawn with the operator handle in the ON position.

B. Switches and Pushbuttons

1. See Section 40 51 50.

C. Relays and Timers

1. See Section 40 51 50.

D. Indicating Lights

1. See Section 40 51 50.

E. Elapsed Time Meters

1. Elapsed time meters (ETM) for general use shall be non-resettable with 0.0 to 99,999.9 hour readout, permanently lubricated synchronous motor drive, nominal 2-1/2” circular two-hole surface mount housing, screw terminals, and rated at 120 VAC, at 60 Hz. Elapsed time meters shall be Cramer 635, Stemco-Engler Series 210, or approved equal.

F. Terminal Blocks

1. See Section 40 51 50.

G. Fuses

1. Fuses shall be sized in conformance with the CEC/NEC.
2. Fuses used in circuits 200 VAC and above shall be time- delay type FNQ or approved equal, 13/32" x 1-1/2", and have an interrupting rating of 10,000 AIC at 500 VAC. Fuse holders shall be of the barrier type and rated 600 VAC.
3. Fuses used in 120 VAC circuits shall be fast-acting type CC or approved equal, 13/32" x 1-1/2", and have a rating of 250 VAC. Fuse-holders shall be of the terminal block type, Littelfuse type LPSM ID to match Owner standard.
4. Fuses used in signal and 24 VDC circuits shall be fast acting type GMA or approved equal, 5mm x 20 mm and have a rating of 250 VAC. Fuse-holders shall be of the terminal block type.

2.06 BUS BARS

A. Horizontal Power Bus

1. The horizontal bus shall be rated as shown on the drawings.
2. The horizontal bus material shall be copper with tin plating.
3. The horizontal bus shall be supported, braced and isolated from the vertical bus with a high strength, non-tracking glass polyester material.
4. For standard sections the horizontal bus shall be continuous within each shipping block and shall be braced within each section.
5. Horizontal bus splices shall have at least 2 bolts on each side.

B. Ground Bus

1. Provide a ground bus system consisting of a horizontal ground bus connected to vertical ground buses mounted in each section.
2. Provide an unplated copper (0.25 inch by 2 inch) horizontal ground bus mounted in the bottom of the MCC unless otherwise specified in the drawings.
3. Provide a pressure type mechanical lug mounted on the ground bus in the incoming line section.
4. Provide a unit ground stab on all unit inserts. The ground stab shall establish unit insert grounding to the vertical ground bus before the plug-in power stabs engage the power bus. The grounding shall be maintained until after the plug-in power stabs are disengaged.
5. Provide an unplated copper vertical unit load ground bus in each standard vertical section.
6. Provide a unit load connector on all units. The load connector shall provide a termination point for the load ground cable at the unit.

C. Neutral Bus

1. If a 4-wire system is specified, yet there are no neutral loads in the MCC, only a neutral connection plate is required in the MCC; i.e. a full neutral bus is not required.
2. If neutral loads are specified within the MCC, a full neutral bus is required. Provide a neutral bus across the full width of the MCC, an incoming neutral lug pad in the incoming section, and neutral connection plates in sections as required.

2.07 DISCONNECTS

A. The withstand rating of the main shall be greater than or equal to the bus bracing for the MCC.

B. Provide lugs to accommodate the conductors as indicated on the drawings.

C. If no overcurrent protection is indicated, provide a main incoming lug compartment.

D. Fusible disconnect assemblies where specified in Drawings shall comply with Section 26 18 11 – Overcurrent Protection Devices.

E. Circuit breaker disconnect assemblies specified in Drawings shall comply with Section 26 18 11 – Overcurrent Protection Devices.

F. Provide a removable protective barrier to reduce the possibility of contact with the line terminals.

G. Provide one normally open and one normally closed internal auxiliary contact on disconnect device.

2.08 COMBINATION NEMA RATED ACROSS THE LINE STARTERS

A. Starters shall be of NEMA design. Starters shall have molded coils, replaceable contacts and metal housing plate. NEMA rated / IEC designed starters will be rejected.

B. Starters shall be provided with a 3-pole Class 20 solid state overloads unless noted otherwise. The overload shall provide overload and phase loss protection.

C. Starters shall be provided with a minimum of (1) N.O. and (1) N.C. auxiliary contact in addition to the hold in contact and auxiliary contacts shown on the drawings up to a maximum of seven beyond the hold-in contact.

D. Provide a control power transformer with a VA rating of at least twice the sealed VA rating of the starter. Provide both primary and secondary fuse protection for the starter.

2.09 REDUCED VOLTAGE SOFT STARTER (RVSS)

A. Controller shall be Cutler-Hammer type S811.

B. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing.

C. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV.

D. Units using triacs or SCR/diode combinations shall not be acceptable.

E. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects

F. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.

G. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.

H. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current.
I. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
J. Digital interface module mounted on the face of the S811 shall be used to program the soft starter. Display shall include six line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions.
K. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via digital interface module.
L. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter.
M. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad.
N. Starter shall be capable of either an electronic or mechanical reset after a fault.
O. Units using bimetal overload relays are not acceptable.
P. Overtemperature protection (on heat sink) shall be standard.
Q. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via digital interface module.
R. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via digital interface module.
S. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via digital interface module.
T. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via digital interface module.
U. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload)
V. The following control function adjustments from digital interface module are required:
    1. Selectable Torque Ramp Start or Current Limit Start
    2. Adjustable Kick Start Time: 0–2 seconds
    3. Adjustable Kick Start Torque: 0–85%
    4. Adjustable Ramp Start Time: 0.5–180 seconds
    5. Adjustable Initial Starting Ramp Torque: 0–85%
    6. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
W. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues.
X. Maximum continuous operation shall be at 115% of continuous ampere rating Pump Control Option – Provide control algorithm for pump start-up and shut down sequences. Control algorithm shall reduce the potential for water hammer in a centrifugal pump system. Upon a start command, the speed of the motor is increased, under the control of the *IT.* Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close.

Y. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements. The pump control option shall be factory installed.

2.10 CONTROL AND LIGHTING TRANSFORMER

A. Provide control and lighting transformers as shown on drawings. The rating shown on the drawings shall be the minimum acceptable rating.

B. The insulation shall be Class 180ºC insulation with 80ºC rise.

C. Provide thermal magnetic circuit breaker for primary protection.

D. The primary circuit breaker compartment and transformer compartment shall be wired and interlocked together.

E. Provide secondary fuse protection for the transformer.

F. Provide vented doors with filters for NEMA Type 1 with gaskets and NEMA Type 12 structures.

2.11 LIGHTING PANEL

A. Provide distribution panel as shown on the Drawings and per Section 26 24 16 – Panelboards.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine motor control center to provide adequate clearances for installation.

B. Check that concrete pads are level and free of irregularities.

C. Begin work only after unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install motor control center in location shown on Drawings, in accordance with manufacturer's written instructions. Anchor to resist seismic forces as inidicated on Drawings and in accordance with OSHPD's anchorage requirements.

B. Installation shall conform to NECA 402 where not specified under this Section.

C. Tighten accessible bus connection and mechanical fasteners after placing motor control center.

3.03 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage and grounding prior to energizing.

B. Check tightness of accessible bolted bus joints using a calibrated torque wrench per manufacturer's specifications.

C. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

3.04 ADJUSTING

A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.

B. Tighten bolted bus connections in accordance with manufacturer's instructions.

C. Adjust circuit breaker trip and time delay settings to values indicated as instructed by Engineer.

3.05 CLEANING

A. Touch up scratched or marred surfaces to match original finish

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to wiring devices.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. Federal Specification
    a. W-C-596; Connector, Electrical, Power, General Specification for
    b. W-S-896; Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification)
2. NEMA –National Electrical Manufacturer's Association
    a. WD 1; General Color Requirements for Wiring Devices
    b. WD 6; Wiring Devices-Dimensional Requirements
3. UL -Underwriters Laboratories, Inc.
    a. 20; General-Use Snap Switches
    b. 498; Standard for Attachment Plugs and Receptacles
    c. 943; Standard for Ground-Fault Circuit-Interrupters
    d. 1449; Standard for Transient Voltage Surge Suppressors

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

PART 2 – PRODUCTS

2.01 SWITCHES

A. Wall switches
   1. Specification grade, quiet, AC rated, mechanical, snap type with silver alloy contacts, and shall comply with NEMA WD-1 and Fed. Spec W-S-896.
   2. Rating shall be 20A at 120/277Vac, unless otherwise shown.
   3. Handles shall be nylon; color shall be compatible with adjacent wall finish.
   4. Manufacturers and types
      a. Single pole, single throw
         1) Cooper Wiring Devices #CSB120, Hubbell #CSB120, or equal.
      b. Double pole, single throw
         1) Cooper Wiring Devices #CSB220, Hubbell #CSB220, or equal.
      c. Three way
         1) Cooper Wiring Devices #CSB320, Hubbell #CSB320, or equal.

2.02 RECEPTACLES

A. Standards
   1. Specification grade, NEMA 5-15R configuration grounding type, rated 15A at 125/250Vac that conform to NEMA WD-6 and Fed. Spec W-C-596.
   2. At dedicated receptacle locations and as otherwise noted, use specification grade, NEMA 5-20R configuration grounding type, rated 20A at 125/250Vac that conform to NEMA WD-6 and when possible Fed. Spec W-C-596.
   3. Specialty receptacles shall conform to NEMA WD-6 and UL standards as applicable.

B. Color
   1. General purpose receptacle face shall be nylon; color shall be compatible with adjacent wall finish, unless otherwise indicated.

C. Receptacle types
   1. General purpose single
      a. Provide self-grounding back and side wired with binding head staked terminal screw.
      b. Use Cooper Wiring Devices #5261, Hubbell #5261, or equal for NEMA 5-15R.
      c. Use Cooper Wiring Devices #5361, Hubbell #5361, or equal for NEMA 5-20R.
   2. General purpose duplex

a. Provide self-grounding back and side wired with binding head staked terminal screws and break-off strip for two circuit wiring.

b. Use Cooper Wiring Devices #5262, Hubbell #5262, or equal for NEMA 5-15R.

c. Use Cooper Wiring Devices #5362, Hubbell #5362, or equal for NEMA 5-20R.

3. Transient voltage surge suppressor (TVSS) duplex

   a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral TVSS protection circuit.

   b. Provide LED indicator to verify surge protection and ground, and audible alarm to notify bad ground connection or surge protection expiration.

   c. TVSS characteristics:

      1) 400V clamping voltage.

      2) 280J energy rating.

      3) 150Vac RMS MOV rating

      4) 18kA maximum surge current in all modes (L-N, L-G and N-G)

   d. Use Cooper Wiring Devices #5362_S, no known equal.

4. Isolated ground

   a. Provide receptacle specified within this Section with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.

5. Ground fault circuit interrupter (GFCI) duplex

   a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral solid-state sensing and signaling circuitry capable of detecting and interrupting a maximum 5mA line-to-ground fault current in approximately 1/40th of a second per UL 943.

   b. Provide visual device with trip indication, manual reset and test mechanisms per UL 943.

   c. Device shall be capable of point of use and multi-outlet protection.

   d. Use Cooper Wiring Devices #XGF20, Hubbell #GF53, or equal.

6. Hospital grade and tamper resistant

   a. Provide receptacle specified within this Section that conforms to UL 498 “Hospital Grade” requirements.

   b. Tamper resistance receptacle shall have integral protection mechanism to prevent accidental shock from foreign object contacting energized blades.

7. Special purpose

   a. Provide specification grade devices with NEMA configuration, voltage, ampacity, poles and ground provisions as noted on Drawings.

2.03 WALL PLATES

A. Interior locations

1. Finished Areas: 0.032” stainless steel, brushed or satin finish with required number of openings for location.
2. Exposed Areas: galvanized, raised type.

B. Exterior: die-cast copper-free aluminum, gasketed, raintight cover UL listed for exterior and wet locations while in use. Use Hubbell #WP8M (duplex), #WP26M (GFCI) or equal.

C. Screws shall match plate.

D. Tamper resistance receptacles shall have exposed screws of tamper resistant type.

E. Individual, gangable wall plates are not acceptable where two or more devices are installed at one location.

PART 3 –– EXECUTION

3.01 PREPARATION

A. Coordinate device heights with drawings and details.

B. Locate switches on latch side of door, unless otherwise indicated.

3.02 INSTALLATION

A. Mount and align device and wall plates level and plumb. Ensure wall plates fit flat against wall and tight against device without strain on plate.

B. Comply with manufacturer’s instructions regarding termination of conductors to wiring device.

C. Provide wall plates for all outlet boxes with devices.

D. Install blank wall plates on all outlet boxes in which no device is present or installed.

END OF SECTION

SECTION 26 28 16

SAFETY SWITCHES AND INDIVIDUAL MOUNTED CIRCUIT BREAKERS

PART 1 — GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to heavy duty fusible, non-fusible and double throw safety switches.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
    b. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. NEMA –National Electrical Manufacturer’s Association
    a. KS 1; Enclosed Switches
    b. 250; Enclosures for Electrical Equipment
3. UL -Underwriters Laboratories, Inc.
    a. 98; Enclosed and Dead Front Switches
    b. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures

1.03 SUBMITTALS

A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

1.05 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

A. Square D, Cutler Hammer or approved equal.

2.02 MATERIALS

A. Heavy-duty safety switches

1. Switch interior

a. All switches shall have switch blades which are visible when the switch is OFF, and the cover is open.

b. Lugs shall be front removable and UL Listed for 75°C conductors, aluminum or copper.

c. 30A through 100A switches shall be equipped with factory or field installed fuse pullers.

d. Switches required for Type 12, 12K or Type 4-4X-5 stainless steel applications shall have all copper current carrying parts.

e. All current carrying parts shall be plated to resist corrosion.

f. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

g. Switches shall have provisions for a field installable electrical interlock.

2. Switch mechanism

a. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

b. The operating handle shall be an integral part of the box, not the cover.

c. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.

d. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle.

e. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override, but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

3. Switch enclosures

a. All enclosures shall be NEMA 1 general purpose unless otherwise noted.

b. Switch covers shall be attached:

1) with welded pin-type hinges (Type 1, 12, 12K, 4-4X-5 stainless steel).

2) top hinged, attached with removable screws and securable in the open position (Type 3R).

3) by molded hinges and type 316 stainless steel hinge pins (Type 4X polyester).

4) by type 316 stainless steel bolts (Type 7/9).

c. The enclosure shall be finished with:

1) gray baked enamel paint, which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1).

2) gray baked enamel paint, which is electrodeposited on cleaned, phosphate pre-treated galvannealed steel (Type 3R, 12, 12K).

3) a brush finish on type 304 stainless steel (Type 4-4X-5 stainless steel).

4) Gray baked enamel on copper free cast aluminum alloy (Type 7/9).

d. The enclosure shall have ON and OFF markings:

1) stamped into the cover (Type 1, 3R, 4-4X-5 stainless steel, 12, 12K).

2) cast into the cover (Type 7/9).

3) inked on a adhesive label (Type 4X polyester).

e. The operating handle shall be provided with a dual colored, red/black position indication.

f. All switches shall have provisions to accept up to three 3/8” hasp padlocks to lock the operating handle in the OFF position.

4. Switch ratings
    a. Switches shall be horsepower rated for ac and/or dc as indicated on Drawings.
    b. The UL Listed short circuit current rating of the switches shall be:
        1) 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600A).
        2) 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600A switches employing appropriate fuse rejection schemes).
        3) 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200A)

B. Double throw switches
    1. Shall have the same characteristics as heavy-duty safety switches above for switch interior, mechanism, enclosure and rating.
    2. Additional switch operating mechanism characteristics shall be:
        a. quick-make, quick-break for 60A through 200A, 2 pole and 3 pole devices.
        b. Slow-make, slow-break for
            1) 30A and greater than 200A, 2 pole and 3 pole devices.
            2) 60A through 200A, 4 pole devices.

C. Individual Mounted Circuit Breakers
    1. Circuit Breaker
        a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.
    2. Enclosure
        a. Enclosure shall be galvanized steel constructed in accordance with UL 50 requirements, and be NEMA 1, unless specifically shown or specified otherwise.

PART 3 -EXECUTION

3.01 INSTALLATION

A. The equipment shall be installed per the manufacturer's recommendations.

B. Anchor safety switches to structural members and as shown on Drawings. Provide additional support as required.

C. Mount safety switches level and plumb.

3.02 FIELD QUALITY CONTROL

A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.

B. Check tightness of bolted connections per manufacturer's written specifications.

END OF SECTION

SECTION 26 29 23

VARIABLE-FREQUENCY MOTOR CONTROLLER

PART 1 — GENERAL

1.01 SUMMARY

A. The Variable Frequency Drive (VFD) system shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.

1.02 RELATED SECTIONS

A. 26 05 00 - Basic Electrical Materials and Methods

1.03 REFERENCES

A. National Fire Protection Association - NFPA 70 - US National Electrical Code.

B. National Electrical Manufacturers Association - NEMA 250 - Enclosures for Electrical Equipment.

C. Underwriters Laboratory Inc. – UL 508.

D. Canadian Standards Association International – CAN/CSA-C22.2 No. 14-05.

E. International Electrical Code - IEC 146.

F. Institute of Electrical and Electronics Engineers, Inc. - IEEE 519 - IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.04 SUBMITTALS

A. Submit under provisions of Section 26 05 00

B. Shop Drawings - Approval

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

   a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.

   b. Control Diagram: Include disconnect devices, pilot devices, etc.

4. Major components list.

C. Product Data Sheets

1. VFD and Operator Interface publications.
2. Data sheets and publications on all major components including but not limited to the following:
    a. Contactors
    b. Circuit breaker and fuse (power and control)
    c. Control power transformers
    d. Pilot devices
    e. Relays/Timers

D. Test procedures shall be per the manufacturer's standards.

1.05 CLOSEOUT SUBMITTALS (OPERATION AND MAINTENANCE MANUALS)

A. Submit under provisions of Section 26 05 00

B. Shop Drawings – Final as shipped

1. Elevation Drawings: Include dimensional information and conduit routing locations.
2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.
3. Wiring Diagrams:
    a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.
    b. Control Diagram: Include disconnect devices, pilot devices, etc.
4. Major components list.

C. Product Data Sheets

1. VFD and Operator Interface publications.
2. Data sheets and publications on all major components including but not limited to the following:
    a. Contactors
    b. Circuit breaker and fuse (power and control)
    c. Control power transformers
    d. Pilot devices
    e. Relays/Timers

D. Test procedures shall be per the manufacturer's standards.

E. Operation and Maintenance Data
   1. Service and Contact information
   2. VFD and Operator Interface User Manuals
   3. Troubleshooting / Service Manuals

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturers:
      a. The VFD and all associated optional equipment shall be UL listed or recognized.
      b. The VFD shall contain a UL label attached on the inside of the enclosure cabinet.
   2. Suppliers:
      a. All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third-party registrar.
      b. The VFD shall be factory pre-wired, assembled and tested as a complete package.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall coordinate the shipping of equipment with the manufacturer.
B. Contractor shall store the equipment in a clean and dry space at an ambient temperature range of -25 °C to 55 °C (-13 °F to 130 °F).
C. The contractor shall protect the units from dirt, water, construction debris and traffic.

1.08 WARRANTY

A. The manufacturer shall provide a parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.
B. This warranty applies to variable frequency drive systems.

PART 2 — PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric Altivar 680 or approved equal

2.02 GENERAL DESCRIPTION

A. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage as defined below and indicated on the drawings or motor control schedules.

   1. For AC Drives rated up to and including 100 HP, the AC Drive manufacturer shall use a 6 pulse bridge rectifier design addressed in separate specification.

   2. For AC Drives rated 125–900 HP, the AC Drive manufacturer shall utilize 3-Level Type Active Rectification with integrated power modules and reverse blocking IGBT's that approximates near sinusoidal input current waveform and compliance with requirements of IEEE 519. The power section shall be insensitive to phase rotation of the AC line.

B. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall use insulated gate bipolar transistors (IGBT) or intelligent power modules (IPM) as required by the current rating of the motor.

C. Each input phase of the VFD shall incorporate a symmetrical LCL filter high frequency arranged in a T-configuration. The inductors are to be series power components that carry the full current of the VFD.

D. The VFD shall operate at fundamental power factor 1.0 on the supply side when operating above 30% of rated full load current.

E. The AC Drive shall include a radio frequency interference filter as standard. This filter fulfils the requirements for category "C3 – industrial environments" according to EN/IEC 61800-3 (in the past: EN 55011 class A group 2).

F. The AC Drive shall have an integrated dV/dt filter for ratings at 300HP and above.

G. The AC Drive shall have a bypass solid state reduced voltage starter with integral contactors.

H. The AC Drive shall include from the factory an integral air conditioning unit to meet the Drive's heat rejection with an external ambient of 108 degrees F.

2.03 CONSTRUCTION

A. The AC Drive shall be mounted in a Type 1 enclosure with an externally operated disconnect device. If no indication is made Nema enclosure style will default to Nema 1.

B. A mechanical interlock shall prevent an operator from opening the AC Drive door when the disconnect is in the On position. Another mechanical interlock shall prevent an operator from placing the disconnect in the On position while the AC Drive door is open. It shall be possible for authorized personnel to defeat these interlocks.

C. Provisions shall be made for locking all disconnects in the Off position. Provisions for additional padlocking shall be made by the customer using an approved lockout/tagout device.

D. Enclosure door to come with keyed lock.

2.04 MOTOR DATA

A. The AC Drive shall be sized to operate the following AC motors and shall be defined to match the load schedules and the type of connections used between the motor and the load, such as a direct connection or a power transmission connection:

1. Motor horsepower rating(s) – See motor control schedules.
2. Motor full load ampere ratings coordinated to NEC 2014 Table 430.250.
3. Motor synchronous speed [3600, 1800, 1200] at 60 Hz.
4. Motor utilization voltage [460 Vac]
5. Motor service factor [1.0, 1.15, 1.25]

2.05 APPLICATION DATA

A. The AC Drive shall be sized to operate a variable torque (pumping) load and shall carry a NORMAL DUTY rating.

B. The speed range shall be from a minimum speed of 0.1 Hz to a maximum speed of 60 Hz.

2.06 ENVIRONMENTAL RATINGS

A. The AC Drive shall meet IEC 60664-1 and NEMA ICS-1 Annex A standards.

B. The AC Drive shall be designed to operate in an ambient temperature of -10 to + 40 °C (+14 to 104 °F).

C. The storage temperature range shall be -25 to +70 ° C (-13 to +158 °F).

D. The maximum relative humidity shall be 95% at 40 °C (104 °F), non-condensing with no dripping water, conforming to IEC 60068-2-3.

E. The AC Drive shall be rated to operate at altitudes less than or equal to 3,300 feet (1000 meters) without derating. For altitudes above 3,300 feet (1000 meters), the manufacturer’s derating factors shall apply.

F. The AC Drive shall conform to IEC 600721-3-3-3M3 Amplitude for Operational Vibration Specifications.

G. The AC Drive shall meet environmental conditioning to IEC60721-3-3, electronic cards with protective coating.

2.07 RATINGS

A. The AC Drive shall be designed to operate from an input voltage of 460 Vac plus or minus 10%.

B. The AC Drive shall operate from an input voltage frequency range of 47–63 Hz.

C. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition.

D. The efficiency of the AC Drive at 100% speed and load shall typically not be less than 96%. Efficiency shall vary with the power rating of the AC Drive.

E. The normal duty torque rated AC Drive overcurrent capacity shall be 110% for one minute.

F. The output carrier frequency of the AC Drive shall be randomly modulated depending on the Drive rating for low noise operation. No AC Drive with an operable carrier frequency above 16 kHz shall be allowed.

G. The output frequency shall be from 0.1–200 Hz.

H. The AC Drive shall develop rated motor torque at 0.5 Hz (60 Hz base) in a sensorless flux vector (SVC) mode using a standard induction motor without an encoder feedback signal

2.08 PROTECTION

A. Upon power-up, the AC Drive shall automatically test for valid operation of memory, valid operation of option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power, and the pre-charge circuit.

B. The AC Drive shall be UL Listed according to UL 508A for use on distribution systems with 100 kA available short circuit current and rated per the specification of the customer.

C. The AC Drive shall have protection against short circuits, protection between output phases and ground; and protection between the logic and analog outputs.

D. The AC Drive shall have minimum AC under voltage power loss ride-through of 200 milliseconds. The AC Drive shall have the user-defined option of frequency fold-back to allow motor torque production to continue to increase the duration of the power loss ride-through.

E. The AC Drive shall have a selectable ride-through function that shall allow the logic to maintain control for a minimum of one second with the ability to restart when power is restored.

F. The AC Drive shall have an auto restart function that shall provide programmable restart attempts for a detected trip condition other than a ground fault, short circuit, or internal trip condition. The programmable time delay before restart attempts shall be unlimited.

G. The AC Drive shall have a programmable deceleration mode for normal and tripped conditions. The stop modes shall include freewheel stop, fast stop, and DC injection braking.

H. Upon loss of the analog process follower reference signal, the AC Drive shall enter a tripped condition and/or operate at a user-defined speed set between software-programmed low-speed and high-speed settings.

I. The AC Drive shall have solid state I2t protection that is UL Listed and meets UL 508C as a Class 10 overload protection and meets IEC 60947. The minimum adjustment range shall be from 40–150 % of the nominal output current rating of the AC Drive.

J. A thermal switch with a user selectable pre-alarm shall provide the AC Drive with a minimum of 60 seconds delay before overtemperature trip.

K. The heatsink shall have bonded fin, molded, or block-milled construction for maximum heat transfer.

L. The AC Drive shall have a fold-back function that shall automatically anticipate a controller overload condition and fold back the frequency to avoid a trip condition.

M. The output frequency of the AC Drive shall be software enabled to fold back when the motor is overloaded.

N. There shall be three skip frequency ranges with hysteresis adjustment that can each be programmed independently, back to back, or overlapping.

2.09 ADJUSTMENTS AND CONFIGURATIONS

A. The AC Drive shall self-configure to the main operating supply voltage and frequency. Operator adjustments shall not be required.

B. Upon power up, the AC Drive shall automatically send a signal to the connected motor. The stator resistance data shall be measured at rated current. The AC Drive shall automatically optimize the operating characteristics according to the stored data.

C. The AC Drive shall be factory preset to operate most common applications.

D. A choice of at least two types of acceleration and deceleration ramps shall be available in the AC Drive software: linear and S curve. Other product specific curves may be available.

E. The acceleration and deceleration ramp times shall be adjustable from 0.01 to at least 3,200 seconds.

F. The volts/hertz ratios shall be user selectable to meet variable torque loads, normal, and high-torque machine applications.

G. The memory shall retain and record run status and trip type of at least the past four detected trips.

H. Slip compensation shall be adjustable from 0–150%.

I. The software shall have an “Energy Saving” function that shall reduce the voltage to the motor when the variable torque setting is selected. A constant volts/hertz ratio shall be maintained during acceleration. The output voltage shall then automatically adjust to meet the torque requirement of the load.

J. The AC Drive shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator. The level of current shall be adjustable between 10% and 100% of rated current and available from 1.0 to at least 20 seconds continuously. For continuous operation after 30 seconds, the current shall be automatically reduced to 50% of the nameplate current of the motor.

K. Sequencing logic shall coordinate the engage and release thresholds and time delays for sequencing AC Drive output, mechanical actuation, and DC injection braking in order to accomplish smooth starting and stopping of a mechanical process.

2.10 GRAPHIC DISPLAY TERMINAL INTERFACE

A. The graphic display terminal shall provide 8 lines of 240 by 160 pixels (in English) to control, adjust, and configure the Altivar 680 AC Drive. All electrical values, bar charts, configuration parameters, I/O assignments, application and activity functions, trips, local control, adjustment storage, self-test, and diagnostics shall be accessible through the terminal interface. There shall be a standard selection of six additional languages built into the operating software.

B. The AC Drive model number, torque type, software revision number, horsepower, output current, motor frequency, and motor voltage shall be listed on the drive identification display as viewed on the graphic display terminal.

C. At a minimum, the selectable outputs shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference, and machine speed.

D. The graphic display terminal shall consist of programmable function keys. The functions shall allow both operating commands and programming options to be preset by the operator. A hardware selector switch shall lock out the graphic display terminal from unauthorized personnel.

E. The graphic display terminal shall offer a simple to advanced user menu consisting of parameter setting, I/O map, trip history, and drive configuration. A software lock shall limit access to the main menu.

F. The navigation scheme shall provide the ability to scroll through menus and screens, select or activate functions, or change the value of a selected parameter.

G. An Escape key shall return a parameter to the existing value if an adjustment is not required and the value shall be displayed. The escape function shall also return to a previous menu display.

H. A Run key and a Stop key shall command a normal start and stop as programmed when the AC Drive is in keypad control mode. The Stop key must be active in all control modes.

I. A user interface shall be available that is a WINDOWS® based personal computer, serial communication link, or detachable graphic display terminal.

J. The keypad and all door-mounted controls must be Type 12 rated.

K. The keypad shall offer a QR code for end user troubleshooting. QR code must be integral to the power converter.

2.11 CONTROL

A. Unit shall have Ethernet TCTP/IP embedded in the power converter

B. Unit shall have an Energy meter integral to the power converter. Energy dashboard should be available to view on the display terminal or available to export via Ethernet.

C. External pilot devices may be connected to a terminal strip for starting/stopping the AC Drive, speed control, and displaying operating status. All control inputs and outputs shall be software assignable.

D. A 2-wire or 3-wire control strategy shall be defined within the software. The 2-wire control shall allow automatic restart of the AC Drive without operator intervention after a trip or power restored. The 3-wire control shall require operator intervention to restart the AC Drive after a trip is cleared or power restored.

E. The control power for the digital inputs and outputs shall be 24 Vdc, converter and 120 Vac for external.

F. The internal power supply shall incorporate an automatic current fold-back function that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs shall be current limited to 220 mA and shall not be damaged if shorted or if excess current is pulled.

G. All logic connections shall be furnished on pull-apart terminal strips.

H. There shall be two software assignable analog inputs with interference filtering. The analog inputs shall be software selectable and shall consist of user-defined configurations: x y mA or x y V.

I. There shall be at least four software assignable logic inputs that shall be selected and assigned in the software. The logic input assignments shall consist of forward, reverse, jog, plus/minus speed (2 inputs required), setpoint memory, preset speeds (up to 8 inputs), auto/manual control, controlled stop, terminal or keypad control, output contactor (2 inputs required), motor switching, and trip reset.

J. There shall be at least one software assignable analog output with interference filtering. The analog outputs can be selected and assigned in the software. The analog output assignments shall be proportional to the following motor characteristics: frequency, current, power torque, voltage, and thermal state. The output signal shall be user-defined configurations: x y mA or x y V.

K. Two voltage-free Form C relay output contacts shall be provided. One of the contacts shall indicate AC Drive trip status. The other contact shall be drive run status.

L. There shall be a hardware input/output extension module that also provides interlocking and sequencing capabilities. The module shall be fully isolated and housed in a finger-safe enclosure with pull-apart terminal strips. The module shall add four logic inputs, two analog inputs, two relay outputs, and one analog output. All of the inputs and outputs shall be user assignable in the software as previously defined.

M. The combination enclosure shall have the following optional 22 mm door-mounted operators:

1. Power On pilot light (red)
2. Drive Run pilot light (green)
3. Drive Trip pilot light (yellow)
4. Hand-Off-Auto selector switch
5. Manual speed potentiometer

2.12 BYPASS CIRCUIT – SOLID STATE REDUCED VOLTAGE REQUIRED

A. The AC Drive shall include mechanically, and electrically interlocked isolation and bypass contactors complete with a Class 10 thermal overload relay, control circuit transformer and AFC/OFF/BYPASS switch.

B. The operator shall have full control of the bypass starter by operation of the AFC/OFF/BYPASS selector switch.

C. In the AUTOMATIC mode of operation, the bypass contactors shall be sequenced by the 120-volt rated auto start contact provided by the user.

D. The isolation contactor for the bypass shall be sequenced to provide motor isolation during a drive ready state of operation.

E. Control power for the user inputs shall be supplied internal to the cabinet and shall be 120 Vac for all external field connections.

F. A door-mounted overload relay reset button shall be provided.

G. A Soft Start bypass shall be provided for units [__] HP and above as indicated on the contract drawings for the emergency bypass mode.

H. Soft Start unit shall be Altistart 22 or Altistart 48 from Schneider Electric. If no preference is indicated the default unit will be Altistart 22 with integral shorting contactor.

I. The combination enclosure shall have the following 22 mm door-mounted operators:

1. Power On pilot light (red)
2. Drive Run pilot light (green)

3. Drive Trip pilot light (yellow)
4. Bypass pilot light (yellow)
5. Hand-Off-Auto selector switch
6. Manual speed potentiometer

PART 3 -EXECUTION

3.01 EXAMINATION

A. Verify that location is ready to receive equipment.

B. Verify that the building environment can be maintained within the service conditions required by the manufacturer of the VFD.

3.02 INSTALLATION

A. Installation shall be in compliance with all manufacturer requirements, instructions and drawings.

3.03 START-UP SERVICE

A. At a minimum, the start-up service shall include:
   1. Perform pre-Power Check
   2. Megger Motor Resistances: Phase-to-Phase and Phase-to-Ground
   3. Verify system grounding per manufacturer's specifications
   4. Verify power and signal grounds
   5. Check connections
   6. Check environment

B. Drive Power-up and Commissioning:
   1. Measure Incoming Power Phase-to-Phase and Phase-to-Ground
   2. Measure DC Bus Voltage
   3. Measure AC Current Unloaded and Loaded
   4. Measure Output Voltage Phase-to-Phase and Phase-to-Ground
   5. Verify input reference signal

C. All measurements shall be recorded.

D. Drive shall be tuned for system operation.

E. Drive parameter listing shall be provided.

3.04 TRAINING

A. Manufacturer to provide a quantity of one (1) 4-hour session of on-site instruction.

B. The instruction shall include the operational and maintenance requirements of the variable frequency drive.

C. The basis of the training shall be the variable frequency drive, the engineered drawings and the user manual. At a minimum, the training shall:

1. Review the engineered drawings identifying the components shown on the drawings.
2. Review starting / stopping and speed control options for the controller.
3. Review operation of the Human Interface Module for programming and monitoring of the variable frequency drive.
4. Review the maintenance requirements of the variable frequency drive.
5. Review safety concerns with operating the variable frequency drive.

END OF SECTION

SECTION 26 32 13

ENGINE GENERATOR

PART 1 — GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to engine generators, its accessories and controls.

B. Related work under this section

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
   a. 26 05 26 – Grounding and Bonding for Electrical Systems
   b. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:

1. CCR –California Code of Regulations, Title 24
   a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
   b. Part 9 -California Fire Code; WFCA Uniform Fire Code (UFC) with California amendments
2. FCC Part 15, Subpart B.
3. ISO –International Organization for Standardization
   a. 8528; Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets (All Parts)
4. IEEE –Institute of Electrical and Electronic Engineers
   a. C2; National Electrical Safety Code (NESC)
   b. 446; Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
5. NECA –National Electrical Contractors Association

a. 404; Recommended Practice for Installing Generator Sets

6. NEMA –National Electrical Manufacturer's Association
   a. ICS 1; Industrial Control and Systems: General Requirements
   b. MG 1; Motors and Generators
   c. MG 2; Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators
7. NFPA –National Fire Protection Association
   a. 37; Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
   b. 99; Standard for Health Care Facilities
   c. 110; Standard for Emergency and Standby Power Systems
8. UL -Underwriters Laboratories, Inc.
   a. 508; Standard for Industrial Control Equipment
   b. 2085; Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids
   c. 2200; Standard for Stationary Engine Generator Assemblies

1.03 SYSTEM DESCRIPTION

A. Provide a 750kW standby power system to supply electrical power at 277/480Volts,60 Hertz, 3 Phase, 4 Wire. The generator shall consist of a liquid cooled diesel engine, a synchronous AC alternator, and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.

B. The stand-by generator set shall be supplied to operate on No. 2 diesel fuel. The engine shall be liquid cooled by means of engine mounted radiator.

C. The stand-by generator set shall be rated continuous stand-by (defined continuous for the duration of any power outage) per Part 2 below.

D. Engine: The turbo charged engine shall be diesel fueled, 4 cycle, liquid cooled, with a governed speed of 1800 RPM. Engine shall be turbocharged with intercooler/aftercooler, forged steel crankshaft and rods. Engine shall be equipped with 90% efficient controls for crankcase emissions, in full conformance with the latest and applicable California Air Resources requirements and all local emissions requirements. Submit certifications with the submittals.

1.04 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. The submittal shall contain the following minimum information:

1. Engine Generator specification sheet

2. Controls specification sheet(s)
3. Installation / Layout dimensional drawing
4. Wiring schematic
5. Sound data
6. Emission certification
7. Warranty statement

C. Manufacturer shall assist Owner in acquiring all necessary CARB installation and initial operation permits for the gen-set.

1.05 QUALITY ASSURANCE

A. Installation shall conform to NECA 404, Recommended Practice for Installing Generator Sets unless otherwise specified.

B. The engine shall be equipped with all devices and accessories required to meet the California Air Resources Board and other applicable State and Local emissions standards.

1.06 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

1.07 WARRANTY

A. Furnish one-year guarantee in accordance with and in form required under Section 26 05 00.

B. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

C. Service and support

1. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
2. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in-service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
3. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

1.08 SYSTEM STARTUP

A. Refer to manufacturer's documentation to start-up procedures and requirements.

PART 2 — PRODUCTS

2.01 MANUFACTURER

A. All equipment shall be new and of current production of a National firm, who manufactures the generator, engine, control panel, acoustical assemblies comprising the stand-by generator set as a matched unit, having a service and parts organization.

B. Cummins DQCB or equivalent

1. 6750kW Sound Attenuated, Second Stage

a. The generator set shall operate at 1800 RPM and at a voltage of: 277/480Vac, 3 phase, Four-wire, 60 Hz.

b. The generator set shall be rated at 750kW, 938kVA, 1128A at 0.8 PF.

c. The alternator shall support 448 skVA with a maximum voltage dip of 15%.

2. Ratings

a. Ratings based on site conditions of: Altitude 215 ft. ambient temperatures up to 122ºF

b. The generator set rating shall be based on emergency/standby service.

2.02 ENGINE

A. Engine Rating and Performance

1. The prime mover shall be a liquid cooled, diesel fueled, turbocharged after-cooled engine of 4-cycle design. It will have adequate horsepower to achieve rated kW output with at an operating speed of 1800 RPM.

2. The engine shall support a 100% load step.

3. The generator system shall support generator start-up and load transfer within 10 seconds.

B. Engine Oil System

1. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).

2. The engine shall operate on mineral based oil. Synthetic oils shall not be required.

3. The oil shall be cooled by a oil cooler which is integrated into the engine system.

C. Engine Cooling System

1. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system. The coolant system shall include a coolant fill box which will provide visual means to determine if the system has adequate coolant level. The radiator shall be designed for operation in 122 degrees F, (50 degrees C) ambient temperature.
2. The engine shall have (a) unit mounted, thermostatically controlled water jacket heater(s) to aid in quick starting. The wattage shall be as recommended by the manufacturer.
3. Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base for cleaner and more convenient engine servicing.
4. A radiator fan guard must be installed for personnel safety that meets UL and OSHA safety requirements.

D. Engine Starting System

1. Starting shall be by a solenoid shift, DC starting system.
2. The engine's cranking batteries shall be lead acid. The batteries shall be sized per the manufacturer's recommendations. The batteries supplied shall meet NFPA 110 cranking requirements of 90 seconds of total crank time. Battery specifications (type, amp-hour rating, cold cranking amps) to be provided in the submittal.
3. The genset shall have an engine driven, battery charging alternator with integrated voltage regulation.
4. The genset shall have an automatic dual rate, float equalize, 10-amp battery charger. The charger must be protected against a reverse polarity connection. The chargers charging current shall be monitored within the generator controller to support remote monitoring and diagnostics. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

E. Engine Fuel System

1. The engine fuel system shall be designed for operation on #2 diesel fuel and cold weather diesel blends.
2. The engine shall include a primary fuel filter, water separator, manual fuel priming pump, and engine flexible fuel lines must be installed at the point of manufacture. Element shall be replaceable paper type.
3. The engines suction line shall be fitted with a check valve to secure prime for the engines injection pump.

F. Engine Controls

1. Engines that are equipped with an electronic engine control module (ECM), shall monitor and control engine functionality and seamlessly integrate with the genset controller through digital communications. ECM monitored parameters shall be integrated into the genset controllers

NFPA 110 alarm and warning requirements. All ECM fault codes shall be displayed at the genset controller in standard language - fault code numbers are not acceptable.

2. For engines without ECM functionality or for any additional genset controller monitoring, sensors are to be conditioned to a 4-20ma signal level to enhance noise immunity and all sensor connections shall be sealed to prevent corrosion.

3. Engine speed shall be controlled with an integrated isochronous governor function with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25%.

G. Engine Exhaust & Intake

1. The engine exhaust emissions shall meet the EPA emission requirements for standby power generation.

2. The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. A rain cap will terminate the exhaust pipe after the silencer. All components must be properly sized to assure operation without excessive back pressure when installed.

3. The manufacturer shall supply a critical grade exhaust silencer as standard. For applications with site specific sound requirements (reference section 1.1), the silencer shall be selected to achieve site sound levels.

4. For gensets in a weather or sound attenuated enclosure, all exhaust piping from the turbo-charger discharge to the silencer shall be thermally wrapped to minimize heat dissipation inside the enclosure.

5. The engine intake air is to be filtered with engine mounted, replaceable, dry element filters.

2.03 ALTERNATOR

A. The alternator shall be the voltage and phase configuration as specified in this Section.

B. The alternator shall be a 4 pole, revolving field, stationary armature, synchronous machine. The excitation system shall utilize a brushless exciter with a three-phase full wave rectifier assembly protected against abnormal transient conditions by a surge protector. Photo-sensitive components will not be permitted in the rotating exciter.

C. The alternator shall include a permanent magnet generator (PMG) for excitation support. The system shall supply a minimum short circuit support current of 300% of the rating (250% for 50Hz operation) for 10 seconds.

D. Three phase alternators shall be 12 lead, broad range capable of supporting voltage reconnection. Single phase alternators shall be four lead and dedicated voltage designs (600v) shall be six lead. All leads must be extended into a NEMA 1 connection box for easy termination. A fully rated,

isolated neutral connection must be included by the generator set manufacturer.

E. The alternator shall use a single, sealed bearing design. The rotor shall be connected to the engine flywheel using flexible drive disks. The stator shall be direct connected to the engine to ensure permanent alignment.

F. The alternator shall meet temperature rise standards of UL2200 (120 degrees C). The insulation system material shall be class "H" capable of withstanding 150 degrees C temperature rise.

G. The alternator shall be protected against overloads and short circuit conditions by advanced control panel protective functions. The control panel is to provide a time current algorithm that protects the alternator against short circuits. To ensure precision protection and repeatable trip characteristics, these functions must be implemented electronically in the generator control panel -- thermal magnetic breaker implementation are not acceptable.

H. An alternator strip heater shall be installed to prevent moisture condensation from forming on the alternator windings. A tropical coating shall also be applied to the alternator windings to provide additional protection against the entrance of moisture.

2.04 CONTROLS

A. The generator control system shall be a fully integrated microprocessor-based control system for standby emergency engine generators meeting all requirements of NFPA 110 level 1.

B. The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including engine protection, alternator protection, speed governing, voltage regulation and all related generator operations. The generator controller must also provide seamless digital integration with the engine's electronic engine control module (ECM) if so equipped. Generator controller's that utilize separate voltage regulators and speed governors or do not provide seamless integration with the engine management system are considered less desirable.

C. Communications shall be supported with building automation via the Modbus protocol without network cards. Optional internet and intranet connectivity shall be available.

D. The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.

E. Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.

F. A predictive maintenance algorithm that alarms when maintenance is required. The controller shall have the capability to call out to the local servicing dealer when maintenance is required.

G. Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, simultaneous monitoring of all input or output parameters, callout capabilities, support for multi-channel digital strip chart functionality and .2 msec data logging capabilities.

H. In addition to standard NFPA 110 alarms, the application loads should also be protected through instantaneous and steady state protective settings on system voltage, frequency, and power levels.

I. The control system shall provide pre-wired customer use I/O: 4 relay outputs (user definable functions), communications support via RS232, RS485, or an optional modem. Additional I/O must be an available option.

J. Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality inside the generator controller shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.

K. The control panel will display all user pertinent unit parameters including: engine and alternator operating conditions; oil pressure and optional oil temperature; coolant temperature and level alarm; fuel level (where applicable); engine speed; DC battery voltage; run time hours; generator voltages, amps, frequency, kilowatts, and power factor; alarm status and current alarm(s) condition per NFPA 110 level 1.

2.05 ENGINE / ALTERNATOR PACKAGING

A. The engine/alternator shall be isolated from the generator frame with rubber isolators. The packaging shall not require the addition of external spring isolators.

B. A mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The breaker shall rate between 100 to 125% of the rated ampacity of the genset. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.

C. A second mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.

D. The generator shall include a unit mounted 120-volt convenience outlet.

E. Enclosure

1. The genset shall be packaged with a sound attenuating enclosure with a maximum rating of 76dBA at any location 23 feet from the generator set in a free field environment.

2. The enclosure shall be completely lined with sound deadening material. This material must be of a self-extinguishing design.

3. The enclosure shall be made of steel with a minimum thickness of 14 gauge. The enclosure is to have hinged, removable doors to allow access to the engine, alternator and control panel. The hinges shall allow for door fit adjustment. Hinges and all exposed fasteners will be stainless steel or JS5000. The use of pop-rivets weakens the paint system and not allowed on external painted surfaces. Key-locking and pad-lockable door latches shall be provided for all doors.
4. The enclosure shall be coated with electrostatic applied powder paint, baked and finished to manufacturer's specifications. The color will be manufacturer's standard.
5. The enclosure shall utilize an upward discharging radiator hood. Due to concerns relative to radiator damage, circulating exhaust, and prevailing winds, equipment without a radiator discharge hood will not be acceptable.
6. The genset silencer shall be mounted on the discharge hood of the enclosure. Due to architectural concerns, silencers mounted on the top of the generator enclosure are not acceptable. Gensets with silencers mounted inside the main generator compartment are acceptable only if the silencer is thermally wrapped to minimize heat stress on the surrounding components.

F. Base:

1. The engine-generator set shall be mounted with vibration isolators Caldyn or equal, on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate a battery tray with battery hold-down clamps within the base rails.

G. Sub-base fuel tank

1. The packaging shall include a double wall, sub-base mounted, UL142 listed fuel tank. The tank shall be sized to provide 24 hours of run time.
2. The tank shall include fuel suction and return connections, normal and emergency vents, secondary containment emergency vent and rupture basin sensor, mechanical fuel level indication and a stub-up area convenient for electrical conduit entry.
3. The fuel tank shall use an electric fuel sensor to provide an analog indication of fuel level. The controller shall have a warning indication on low fuel level and provide optional shutdown functionality for low, low fuel level.
4. The fuel tank shall have a sloped top and bottom. The sloped top allows water to run off. The sloped bottom allows the water and other impurities in the fuel to collect near the back of the tank away from the fuel suction point.
5. The fuel tank must be supplied by the engine-generator set manufacturer and be installed before shipment.

2.06 LOOSE ITEMS

A. Supplier to itemize loose parts that require site mounting and installation. Preference will be shown for gensets that factory mount items like mufflers, battery chargers, etc.

B. Spare Parts:

1. Fuses: One spare set
2. Filters One spare set (air, fuel, oil)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed by the contractor in accordance with final submittals and Drawings. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier. Provide flexible electrical connections from pad to equipment.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer’s instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.02 STARTUP AND COMMISSIONING

A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:

1. Ensuring the engine starts (both hot and cold) within the specified time.
2. Verification of engine parameters within specification.
3. Verify no load frequency and voltage, adjusting if required.
4. Test all automatic shutdowns of the engine-generator.
5. Perform a load test of the electric plant, ensuring full load frequency and voltage are within specification by using building load.

B. Provide documentation of the above tests in accordance to NFPA 110.

3.03 TESTING

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two-hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

D. After installation, the Contractor shall demonstrate to the Owner and the Local Fire Authority that the fuel system is complete, without leaks and is seismically braced.

3.04 TRAINING

A. Training is to be supplied by the start-up technician during commissioning. The training should cover basic generator operation and common generator issues that can be managed by the end-user.

B. Training is to include manual operation of system.

END OF SECTION

SECTION 26 36 00

AUTOMATIC TRANSFER & BYPASS-ISOLATION SWITCH

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to automatic transfer switches (ATS) or automatic transfer switch with by-pass switch (ATS/BPS).

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. NEMA –National Electrical Manufacturer's Association
    a. ICS10-1993 (formerly ICS2-447) -AC Automatic Transfer Switches
3. NFPA –Nation Fire Protection Association
    a. NFPA 99 -Essential Electrical Systems for Health Care Facilities
    b. NFPA 110 -Emergency and Standby Power Systems
4. UL -Underwriters Laboratories, Inc.
    a. UL 508 Industrial Control Equipment
    b. UL 1008 -Standard for Transfer Switch Equipment

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and instrument details.

1.04 QUALITY ASSURANCE

A. The complete assembly shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

B. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Emerson Power/ASCO Series 7000 or approved equal.

2.02 EQUIPMENT

A. Mechanically Held Transfer Switch

1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

3. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfers between two active power sources are not acceptable.
7. Where neutral conductors must be switched as shown on the plans, the AS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts that do not overlap are not acceptable.
8. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

B. Bypass-Isolation Switch (only as noted on Drawings)

1. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
2. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.
3. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
4. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs that disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
5. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the

automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

6. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
7. Designs requiring operation of key interlocks for bypass isolation or ATS's that cannot be completely withdrawn when isolated are not acceptable.

C. Microprocessor Controller

1. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
2. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60°C and storage from -55 to +85°C.
3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
4. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
5. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
   a. IEEE472 (ANSI C37.90A) Ring Wave Test.
   b. ENC55011 1991 Class A Conducted and Radiated Emission.
   c. EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
   d. EN61000-4-3 Radiated Electromagnetic Field Immunity.
   e. EN61000-4-4 Electrical Fast Transient Immunity.
   f. EN61000-4-5 Surge Immunity.
   g. ENV50141 HF Conducted Disturbances Immunity.

D. Enclosure

1. The ATS/BPS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.
2. All standard and optional door-mounted switches and pilot lights shall be 16mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

2.03 OPERATION

A. Controller Display and Keypad

1. A four-line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

   a. Nominal line voltage and frequency

   b. Single or three phase sensing

   c. Operating parameter protection

   d. Transfer operating mode configuration: (Open transition, Closed transition or Delayed transition)

2. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

B. Voltage, Frequency and Phase Rotation Sensing

1. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	(Dropout/Trip)	(Pickup/ Reset)
Undervoltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Unbalance	N&E	5 to 20%	1% below dropout

2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

3. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

4. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

5. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

C. Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

3. Two-time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One-time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5-minute time delay in any of the following modes:
    a. Prior to transfer only.
    b. Prior to and after transfer.
    c. Normal to emergency only.
    d. Emergency to normal only.
    e. Normal to emergency and emergency to normal.
    f. All transfer conditions or only when both sources are available.
6. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:
    a. 1 to 5-minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
    b. 0.1 to 9.99 seconds time delay on an extended parallel condition of both power sources during closed transition operation.
    c. 0 to 5-minute time delay for the load disconnect position for delayed transition operation.
7. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
8. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

D. Additional Features

1. A three-position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
2. Auxiliary contacts rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
3. LED indicating lights (16mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
4. LED indicating lights (16mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and

emergency sources, as determined by the voltage sensing trip and reset settings for each source.

5. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
6. Terminals shall be provided for a remote contact that opens to signal the ATS to transfer to emergency and for remote contacts that open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
7. An inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.
8. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
9. System Status -The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.
10. Self-Diagnostics -The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status-input signals to the controller that may be preventing load transfer commands from being completed.
11. Communications Interface –The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.
12. Data Logging –The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
    a. Event Logging
        1) Data and time and reason for transfer normal to emergency.
        2) Data and time and reason for transfer emergency to normal.
        3) Data and time and reason for engine start.
        4) Data and time engine stopped.
        5) Data and time emergency source available.
        6) Data and time emergency source not available.
    b. Statistical Data
        1) Total number of transfers.

2) Total number of transfers due to source failure.

3) Total number of days controller is energized.

4) Total number of hours both normal and emergency sources is available.

13. Communications Module -A full duplex RS485 interface shall be installed in the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices. The serial communication interface shall be equal to ASCO Accessory 72.

2.04 WITHSTAND AND CLOSING RATINGS

A. The ATS/BPS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.

B. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATS/BPS's which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine ATS to provide adequate clearances for installation.

B. Check that concrete pads (floor mounted models) and walls (wall mounted models) are level and free of irregularities.

C. Begin work only after unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install switchboard in location shown on Drawings, in accordance with manufacturer's written instructions. Anchor to resist seismic forces as indicated on Drawings and in accordance with California Building Code anchorage requirements. Provide all testing and inspections requirements by inspecting authority.

B. Tighten accessible bus connection and mechanical fasteners after placing switchboard.

3.03 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage and grounding prior to energizing.

B. Manufacturers' field services

1. The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

2. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

3.04 CLEANING

A. Touch up scratched or marred surfaces to match original finish

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 -GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to fixtures, lamps, standards, bases, hangers, supports, reflectors, glassware, lenses, auxiliary equipment, ballasts and sockets.

B. Related work under this section

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI -American National Standards Institute
   a. C78; American National Standard for Electric Lamps
   b. C81; American National Standard for Electric Lampholders
   c. C82; American National Standard for Lamp Ballasts
   d. C136; American National Standard for Roadway and Area Lighting Equipment
2. California Codes of Regulations
   a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
   b. Part 6 -California Energy Code
3. IESNA –Illuminating Engineering Society of North America
   a. RP-16; Nomenclature and Definitions for Illuminating Engineering
4. NECA –National Electrical Contractors Association
   a. NECA/IESNA 500, Recommended Practice for Installing Indoor Commercial Lighting Systems
   b. NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems
   c. NECA/IESNA 502, Recommended Practice for Installing Industrial Lighting Systems

5. UL -Underwriter's Laboratories, Inc.
    a. 935; Standard for Fluorescent-Lamp Ballasts
    b. 1029; Standard for High-Intensity-Discharge Lamp Ballasts
    c. 1574; Standard for Track Lighting Systems

1.03 SUBMITTALS

A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

B. Substituted fixtures shall be submitted with manufacturer's specification sheet and published photometric reports, verified by testing to IES and NEMA standards under controlled laboratory conditions.

1.04 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. Installation shall conform to the following standards:
    1. NECA/IESNA 500, Recommended Practice for Installing Indoor Commercial Lighting Systems
    2. NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems
    3. NECA/IESNA 502, Recommended Practice for Installing Industrial Lighting Systems

1.05 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

1.06 WARRANTY

A. Furnish one-year guarantee in accordance with and in form required under Section 26 05 00.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fixtures shall be of the types, wattages and voltages shown on Drawings.

B. Fixtures shall be UL listed as an entire assembly and for the installed location.

C. Fixtures' mounting trim shall be compatible with ceiling material, coordinate with Drawings for each location. Fixtures delivered which are not compatible shall be returned and replaced at Contractor's expense.

D. Luminaire recessed in fire rated ceiling shall conform to UL Standards, equipped with yoke where in tee ceiling and field fabricated fire protection box in accordance with latest UL Fire Resistance Directory.

E. Fluorescent luminaire lenses shall be Pattern 12 of 100% virgin acrylic with 0.125" thickness except shown or specified otherwise.

F. Equip exposed fluorescent lamps with safety lamp holders or wire guard.

G. Deliver fixtures and other lighting equipment complete with suspension accessories, canopies, castings, sockets, holders, reflectors, ballasts, diffusing material, louvers, frames, and recessing boxes all wired and assembled.

H. Hangers: Swivel-type to allow for free movement of 45 degrees from vertical at canopy and at luminaire housing. Steel tube hangers shall include a 1/16-inch diameter galvanized wire cord or equivalent (100-pound break strength) in stem assembly attached to luminaire housing and building structure. Attach loop with C-type tool applied compression splice.

I. All metal halide lamp luminaires shall be the enclosed type with diffuser or lens to withstand an arc tube rupture.

J. Louvers for fluorescent luminaires which are removable for re-lamping but not hinged shall be securely fastened near each end between the fixture housing and louvers using No. 16 jack chain.

2.02 BALLASTS

A. Ballast(s) in luminaire recessed in fire rated ceiling shall be approved for such use.

B. Ballast installed indoors shall be of encapsulated type for noise control.

C. Use appropriate rated ballast in high or low temperature applications.

D. Compact fluorescent and fluorescent lamp ballasts

1. Ballasts shall be programmed rapid start.
2. Ballasts shall be UL 935 listed, Class P, Type 1 Outdoor, CSA Certified where applicable.
3. The ballast shall meet or exceed ANSI C82.11, where applicable.
4. The ballast shall withstand transients specified within ANSI C62.41 Cat. A.
5. THD (Total Harmonic Distortion) shall be less than 10%.
6. Ballast power factor shall be greater than 98%.
7. The ballast shall have an audible noise rating of Class A or better.

E. High intensity discharge (HID) lamp ballasts

1. Ballasts shall be premium constant wattage (regulator stabilized) type, designed in accordance with all applicable ANSI specifications including ANSI C82.4 and UL 1029.
2. Power factor shall be greater than 90%.
3. Provide protective fusing with HID ballasts or HID fixtures.

F. Lamps

1. Provide lamps in all lighting fixtures shown.

2. Type as noted on the plans, T8 unless noted otherwise.
3. Approved manufacturers are General Electric, Osram Sylvania or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Locate all lighting fixtures by reference to Drawings.

B. Report proposed changes for luminaire locations found necessary due to interference with structure, pipes, ducts, and other items to Owner's representative for direction before installation. Luminaires specified with overall lengths are subject to change. Adjust as directed by Owner's representative.

C. Contractor shall be responsible to coordinate with ceiling installation trade. This will assure that proper fixture type will be furnished to match ceiling system specified.

3.02 INSTALLATION

A. Luminaires shall be properly grounded per CEC Article 410, Parts 17 through 21.

B. Luminaires recessed in fire rated ceilings shall be in accordance with UL Fire Resistance Directory.

C. Install all luminaires true and plumb. Support and mount in accordance manufacturer's instructions and with CEC Article 410, Parts 16 and 76.

3.03 ADJUSTING

A. Particular care shall be used to eliminate light leaks around edge of recessed fixture trims.

3.04 CLEANING

A. Clean all glass and plastic and polish all visible metal parts before submitting job to Owner's representative for final acceptance. Remove all fingerprints and dirt from exposed surfaces. Replace scratched or damaged components at the Contractor's expense.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS

PART 1 –– GENERAL

1.01 SUMMARY

A. Section includes

a. Provide all labor, materials and equipment necessary to complete the installation required for the item specified under this Section, including but not limited to telecommunication system grounding.

B. Related sections

1. Where items specified in other Division 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 27 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
   a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. IEEE –Institute of Electrical and Electronic Engineers
   a. 1100; Recommended Practices Powering and Grounding Electronic Equipment
3. NFPA –National Fire Protection Association
   a. 780; Lightning Protection Code
4. TIA/EIA – Telecommunications Industry Association/Electronic Industries Alliance
   a. 607; Commercial Building Grounding and Bonding Requirements for Telecommunications
5. UL -Underwriters Laboratories, Inc.
   a. 467; Grounding and Bonding Equipment

1.03 SYSTEM DESCRIPTION

A. This Section provides for the grounding and bonding of all electrical and communication apparatus, appliances, components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.

B. Except as otherwise indicated, the complete electrical installation including equipment and metallic raceways, boxes and cabinets shall be completely and effectively grounded in accordance with all Code requirements, whether or not such connections are specifically shown or specified.

C. Provide telecommunication system ground bus bars with each building main telecommunications equipment room or cabinet/rack location. Provide connection between the bus bar and main building reference ground bus, the ground bus of the panelboard serving power to telecommunication equipment, and all telecommunication conduit, cable trays, cable ladders and boxes.

1.04 SUBMITTALS

A. Submit manufacturer's data for equipment and materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

PART 2 -PRODUCTS

2.01 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron body with 150°C molded plastic insulated throat and lay-in ground lug; OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

2.02 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPICES

A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds, Cadweld or equal, or high-pressure compression type connectors, Cadweld, Thomas & Betts or equal.

2.03 BONDING JUMPERS

A. OZ/Gedney Type BJ, Thomas & Betts #3840 series or equal.

2.04 GROUND CONDUCTOR

A. Ground conductor shall be #6 AWG UL labeled, Type THWN insulated copper wire, green in color.

2.05 TELECOMMUNICATION MAIN GROUNDING BUS BAR (TMGB)

A. Provide grounding bus bar at telecommunication backboards, racks and cabinets of the following type:

1. Backboards 4'X8' and greater, floor mounted telecommunication equipment racks/cabinets larger than 60" height or wall mounted cabinets greater than 36" Wx36"H
    a. Provide 1 13.5"x2"x1/4" TK copper bus bar mounted on wall with insulating stand-offs at +96" AFF. Furnish complete with cast copper alloy body Thomas Betts Series 310 or equal lugs for connecting grounding conductors. Attach lugs to bus with appropriate size bronze bolt, flat washer and Belleville washer. All connections shall be torque, and all holes shall be drilled and tapped for single hole lugs. Provide 4 spare lugs with respective spaces.
2. Backboards less than 4'X8', floor/wall mounted telecommunication equipment racks/cabinet less than 60" or wall mounted cabinets less than 36" Wx36"H
    a. Provide an aluminum loadcenter ground kit with 14 terminals minimum, General Electric TGL2 or equal. A minimum of 3 terminals shall accommodate #6 AWG. Mount within enclosure or on backboard at +96" AFF.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Telecommunication system grounding
    1. Bond all telecommunication conduit, cable tray, ladder rack, equipment racks and all other metallic telecommunication infrastructure components to the nearest TMGB using a #6 AWG conductor.
    2. Provide #6 AWG ground within ¾" conduit from each secondary backboard, cabinet, rack, etc. to the BGB.
    3. Install #6 AWG grounding conductor in nonmetallic underground raceways containing only fiber optic cable.
    4. Provide an engraved nameplate mechanically fastened to wall or enclosure adjacent to each TMGB. Nameplate shall be blue with ¼" high white lettering to read "TMGB-(name of enclosure or building)".

3.02 FIELD QUALITY CONTROL

A. Contractor using test equipment expressly designed for that purpose shall perform all ground resistance tests in conformance with IEEE Standard 1100. Contractor shall submit typewritten records of measured resistance values to Engineer for review and approval prior to energizing the system.

B. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with the following resistance limits:
    1. Resistance from ground bus to ground electrode and to earth shall not exceed 5 ohms unless otherwise noted.
    2. Resistance from the farthest panelboard, loadcenter, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed 20 ohms maximum.

C. Obtain and record ground resistance measurements (DC, 60Hz, 10MHz, 20MHz, 33 MHz, 66MHz and 100MHz) both from each TMGB to the ground electrode and from the ground electrode to earth.

D. Inspection

1. The Engineer or Inspector prior to encasement, burial or concealment thereto shall review the grounding electrode and connections.

END OF SECTION

SECTION 27 15 13

COPPER TELECOMMUNICATIONS/DATA CABLING AND DEVICES

PART 1 –– GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to copper data communication cabling systems and copper-based telecommunication, which include.

   a. Category 6 cabling

      1) Provide scheduled station plates at each indicated location. Provide labeled Category 6 modules in the plates, and document per Specifications.

      2) Homerun all station cabling from each universal Category 6 data jack to the indicated MDF or IDF.

      3) Provide Category 6 patch panels where indicated. Terminate and test Category 6 cabling as detailed within the Specifications.

      4) Terminate, test and document Category 5E cabling as detailed within the Specifications.

   b. Category 3, RUS (REA) and USOC telephone cabling

      1) Provide scheduled station plates at each indicated location.

      2) Homerun all station cabling from each telephone jack to indicated cabinet/telephone backboard.

      3) Provide punch blocks as necessary; terminate and test as detailed within the Specifications.

B. Related sections

1. Where items specified in other Division 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.

2. The requirements of this Section apply to all Division 27 work, as applicable.

3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI –American National Standards Institute

   a. ISO/IEC 11801; Information technology - Generic cabling for customer premises

2. CCR –California Code of Regulations, Title 24
    a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. CFR –Code of Federal Regulations
    a. Title 7 –Agriculture, Part 1755 – Telecommunications Standards and Specifications for Materials, Equipment and Construction
    b. Title 47 –Telecommunication, Part 68 – Connection of Terminal Equipment to the Telephone Network.
4. TIA/EIA – Telecommunications Industry Association/Electronic Industries Alliance
    a. Wiring/Cabling Standards
        1) TIA/EIA-568-B.1; Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
        2) TIA/EIA-568-B.2; Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components
        3) TIA/EIA-569-A; Commercial Building Standards for Telecommunications Pathways and Spaces
        4) TIA/EIA-606; Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
        5) TIA/EIA/IS-729; Technical Specifications for 100 Ohm Screened Twisted-Pair Cabling
        6) TIA/EIA-758; Customer Owned Outside Plant Telecommunications Cabling Standard
        7) TSB67; Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
        8) TSB95; Additional Transmission Performance Guidelines for 4-Pair 100 Category 5 Cabling
5. ICEA –Insulated Cable Engineers Association
    a. S-56-434; Polyolefin Insulated Communications Cables For Outdoor Use
    b. S-80-576; Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems
    c. S-90-661; Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems
    d. S-101-699; Standard For Category 3 Individually Unshielded Twisted Pair Indoor Cable For Use In General Purpose Non-Lan Telecommunication Wiring Systems
6. IEEE –Institute of Electrical and Electronic Engineers
    a. C2; National Electrical Safety Code (NESC)
    b. 802.3; Information Technology -Local and Metropolitan Area Networks
    c. 820; Standard Telephone Loop Performance Characteristics
7. NECA –National Electrical Contractors Association

a. NECA/BICSI 568; Standard for Installing Commercial Building Telecommunications Systems

8. UL –Underwriters Laboratories, Inc.
   a. 444; Communications Cables
   b. 497; Standard for Protectors for Paired-Conductor Communications Circuits
   c. 1581; Reference Standard for Electrical Wires, Cables, and Flexible Cords
   d. 1666; Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
   e. 1685; Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
   f. 1863; Standard for Communications-Circuit Accessories
9. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA) Standards
   a. PC-2; Splicing Plastic Insulated Cables
   b. PC-4; Acceptance Tests and Measurements of Telephone Plant
   c. PE-22; Aerial and Underground Telephone Cable
   d. PE-33; Shield Bonding Connectors
   e. PE-39; Filled Telephone Cables
   f. PE-52; Telephone Cable Splicing Connectors
   g. PE-60; Trunk Carrier Systems
   h. PE-74; Filled Splice Closures
   i. PE-87; Terminating (TIP) Cable
   j. PE-89; Filled Telephone Cable with Expanded Insulation
   k. TE&CM Section 644; Design and Construction of Underground Cable

1.03 SYSTEM PERFORMANCE STANRDARDS

A. Voice copper plant
   1. To Universal Service Ordering Code (USOC) Standards (CFR Title 47, Part 68, Subpart F, Section 68.502) and other appropriate authorities.
   2. Where voice plant cabling is specified for connection to RJ-11 or RJ-14 jacks conform to USOC and Category 3 standards as demonstrated using the appropriate test equipment.

B. Category 6 copper cabling plant:
   1. To applicable EIA/TIA standards using a digital cable analyzer as specified herein.

1.04 SUBMITTALS

A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. Installer Qualifications

1. The work performed under this Section shall be certified by the manufacturer of the equipment and components being furnished and be authorized by the manufacturer to install and convey the product warranty and performance guarantee to the Owner upon completion of Contract.

2. Installing Contractor must have a minimum of three years previous experience in data communications and/or telecommunication systems installation. All Contractors and/or Vendors supplying all or parts of the work described herein shall supply three project references within the Submittal package at the Engineer's request, which substantiate the Contractor/Vendors' previous experience as noted herein.

C. Testing Equipment

1. Furnish in conformance with the applicable requirements of this Section.

2. Test systems using at least one each of the following test measurement devices or approved functional equivalents:

a. Digital cable analyzer with applicable copper and/or fiber testing standards required within this Section.

b. Cabling plant tester capable of detecting shorts, opens, reversals and miswires.

c. Tone test set capable of analyzing line condition of voice lines.

d. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

1.06 DELIVERY, STORAGE AND HANDLING

A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.

B. Handle carefully to avoid damage to internal components, enclosure and finish.

C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

1.07 WARRANTY

A. Furnish guarantee in accordance with and in form required under Section 26 05 00.

B. Provide 15-year manufacturer's warranty covering application assurance, product, cable, and labor for installations performed by a certified installer using the manufacturer's connecting hardware and qualified cables.

PART 2 -PRODUCTS

2.01 DATA/VOICE CATEGORY-6 RATED COPPER CABLES

A. General

1. Exceeds EIA/TIA-568 Category 6 requirements and tested to 300Mhz.
2. Conductors shall be no small than 24AWG solid annealed bare copper.
3. Outdoor, underground cables must be UL listed for wet applications.
4. Cabling construction and use shall comply with CEC Article 800.

B. Indoor, General (Type CM/CMG/CMR/CMP)

1. Drawing Reference: UTP6-4
2. Cables installed within vertical shafts or risers shall be Type CMR or CMP listed.
3. Construction: Thermoplastic insulated 8 conductor (4 pair) assembly with flame retardant PVC jacket.
4. Manufacturer: Commscope UltraMedia, Mohawk AdvanceNet, Superior Essex NetGain or approved equal.

C. Indoor, Plenum (Type CMP)

1. Drawing Reference: UTP6-4P
2. Construction: FEP/PE insulated 8 conductor (4 pair) assembly with low smoke PVC/FEP jacket.
3. Manufacturer: Commscope UltraMedia, Mohawk AdvanceNet, Superior Essex NetGain or approved equal.

D. Outdoor, Underground

1. Drawing Reference: UTP6-4OP
2. Construction: FEP/PE insulated 8 conductor (4 pair) assembly with floodant compound and PE jacket.
3. Manufacturer: Mohawk AdvanceNet or approved equal.

E. Indoor, Shielded (Type CM/CMG/CMR/CMP)

1. Drawing Reference: STP6-4
2. Construction: FEP/PE insulated 8 conductor (4 pair) with an overall tape/drain shield and flame retardant PVC or low smoke PVC/FEP jacket.
3. Manufacturer: Mohawk AdvanceNet or approved equal.

F. Outdoor, Underground Shielded

1. Drawing Reference: STP6-4OP
2. Construction: PE/PVC insulated 8 conductor (4 pair) with an overall tape/drain shield, floodant compound and PE/PVC jacket.
3. Manufacturer: Mohawk AdvanceNet or approved equal.

2.02 TELEPHONE PLANT COPPER CABLES

A. General

1. Cables which interconnect interior distribution centers and terminate at station jacks shall conform to ICEA S-80-576, Category 1 or Category 3 standards.
2. Conductors shall be 22AWG solid annealed bare copper with minimum pair counts indicated on the plans.
3. Outdoor, underground cables must be UL listed for wet applications.
4. Cabling construction and use shall comply with CEC Article 800.

B. Indoor, General (Type CM/CMG/CMR/CMP)

1. Drawing Reference: UTP-##, where ## refers to required pair count
2. Cables installed within vertical shafts or risers shall be Type CMR or CMP listed.
3. Construction: Thermoplastic insulated conductors situated as paired assemblies with a flame-retardant PVC jacket.
4. Manufacturer: Belden, Mohawk or approved equal.

C. Indoor, Plenum (Type CMP)

1. Drawing Reference: UTP-##P, where ## refers to required pair count
2. Construction: FEP/PE insulated conductors situated as paired assemblies with a low smoke PVC/FEP jacket
3. Manufacturer: Belden, Mohawk or approved equal.

D. Outdoor, Underground Within Duct

1. Less than (≤) 4 pair trunk cables
   a. Drawing Reference: STP-##OP, where ## refers to required pair count
   b. Construction: Polyolefin, PE or PVC insulated conductors situated as paired assemblies with a foil shield, floodant compound and PE jacket.
   c. Manufacturer: Belden, Westpenn Aquaseal or approved equal.
2. Greater than (>) 4 pair trunk cables
   a. Drawing Reference: STP-##OP, where ## refers to required pair count
   b. Construction:
      1) Shall be RUS (REA) PE-89 listed, and suitable for direct burial.
      2) PE jacket with aluminum tape shield and flooded core assembly.
      3) The core assembly shall consist of twisted pair cables with: polyolefin insulation.
   c. Manufacturer: General Cable, Superior Essex SEALPIC-FSF or approved equal.

2.03 DATA/VOICE STATION JACKS & MODULES

A. General Jack and Module Requirements

1. Meets or exceeds the following configuration and performance standards where applicable:
   a. EIA/TIA 568B

b. ISO/IEC 11801, Class E

c. UL1863

d. CEC/NEC Article 800

e. FCC Part 68

2. High impact flame retardant thermoplastic.

3. Integral locking mechanism upon insertion of a modular plug.

B. Voice jack USOC grade

1. Six (6) position, RJ25 configuration jack conforming to USOC requirements.

2. Manufacturers

a. Leviton, Siemon or approved equal.

C. Voice and/or data jack, Category 3

1. Eight (8) position, RJ45 configuration jack conforming to EIA/TIA 568B and USOC requirements.

2. Manufacturers

a. Leviton, Siemon or approved equal.

D. Data jack Category 6

1. Eight (8) position, RJ45 configuration jack conforming to EIA/TIA 568B requirements.

2. Manufacturers

a. Leviton eXetreme, Siemon Ultra Max or approved equal.

2.04 TELECOMMUNICATION STATION PLATES

A. Modular plates

1. Construction

a. Modular, with snap-in receptacle options as scheduled.

b. Single gang plate size and mounting.

c. Options for 1 to 6 modular jacks per plate.

d. Plate face shall be nylon; color shall be compatible with adjacent wall finish, unless otherwise indicated.

e. Integral labeling provided for plate identifier and identifier for each receptacle on the plate. Provide as follows:

1) Plate nominally 1-½" by ½" recessed slot with clear plastic cover over paper label. See labeling requirements in Part 3 of this Section.

2) Receptacle identifier(s) shall be iconic or literal descriptions of each receptacle type.

f. System shall provide at minimum the following receptacle options:

1) RJ45 Category 3 or RJ25 voice

2) RJ45 Category 6 data
3) 75Ω BNC
4) 75ΩF
5) Phono (RCA) type
6) ST fiber adapter
7) SC fiber adapter
8) S video
9) Blank plate fillers as required to fill unused area.

2. Manufacturers
   a. Leviton QuickPort MOS, Siemons CT or approved equal

B. Wall phones plates (non-VOIP or Category-6 jack type)
1. Construction
   a. Single gang plate size and mounting.
   b. Plate face shall be stainless steel with 2 mounting stud type screws for mounting of telephone handset; unless otherwise indicated.
   c. Jack shall be USOC voice grade as described above.

2.05 CABLE TERMINATION EQUIPMENT AND RELATED, CATEGORY RATED

A. Data Patch Panels, Category 6 Rated, Rack Mounted
1. Drawing Reference: ##C6PP, where ## refers to port count.
2. Functions/Features
   a. 19” EIA rack mountable.
   b. 24 ports per one (1) EIA rack unit (1.75”) minimum, unless otherwise noted on Drawings.
   c. Keyed, block form RJ-45/Category 6 jacks and 110 terminations meeting specifications elsewhere herein.
      1) Arranged in rows on steel panel.
      2) Jacks on front and terminations on rear.
   d. Port identifier label space on front.
   e. Provide wire management rings in a ratio of at least 4 rings for every 24 ports.
3. Manufacturers
   a. Leviton, Siemon or approved equal.

B. Category 3 Terminal Block with Pre-Wired RJ21C Connector
1. Drawing reference: 110PWTB##, where ## refers to pair count.
2. Features/Functions

a. Type 110 terminal block with pre-wired RJ21C 50 pin connector on block or on end of pigtail stub cable.

b. Meets Category 3 specifications.

3. Manufacturers

a. Siemon S110A series, Siemon S700 or approved equal.

C. Category 3 Rack Mount Patch Panels with Pre-Wired RJ21C Connector

1. Drawing reference: ##110PWC3PP, where ## designates port count.

2. Features/Functions/Construction

a. 19” EIA rack mount panel.

b. Front face: RJ45 jacks

c. Rear face: Pre-wired RJ21C 50 pin connector(s).

d. Printed Circuit board linking RJ45’s to RJ21C – all four pairs wired straight through.

e. Meets Category 3.

f. At least 24 Jacks per rack unit (RU).

3. Manufacturers

a. Siemon, Signamax or approved equal.

2.06 MISCELLANOUS DEVICES

A. Shield Connectors

1. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar or wire.

2. The connector shall be made of tin-plated tempered brass.

3. RUS PE-33 compliant.

4. Manufacturers

a. Preformed Line Products Servi-Bond or approved equal.

B. Grounding Braid

1. Ground braid shall provide low electrical impedance connections for dependable shield bonding.

2. The braid shall be made from 1/2” wide flat tin-plated copper, length as required.

3. Provide eyelets as necessary for bonding purposes.

4. Manufacturers

a. Thomas Betts, 3M or approved equal.

PART 3 -EXECUTION

3.01 EXAMINATION

A. Verify that all raceways have been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceways are clear of foreign matter and substances prior to installation of wire or cable.

B. Inspect all conduit bends to verify proper radius. Comply with Code and cable manufacturer requirements for minimum permissible radius and maximum permissible deformation.

3.02 INSTALLATION

A. Separation of Wires: Comply with EIA/TIA-569 rules and CEC/NEC 800-52 for separation of unshielded copper voice and data system cables from potential EMI sources, including electrical power lines and equipment.

B. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and CEC/NEC 800.

C. Unless otherwise noted, all trunk and backbone cables and conductors shall have surge and ground protection installed at each end which meets RUS PE-60 requirements. Refer to requirements herein and within the referencing Section as to the acceptable products in each application.

D. Wire and cable installation:

1. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

2. At designated splices, maintain conductor color code across all splices.

3. Copper conductor voice cable outside plant splicing shall be accomplished in accordance with RUS PC-2.

4. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.

5. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

6. Outdoor splices shall not be permitted except where specifically noted or where required by the run length. Where run lengths require outdoor splices not noted on the drawings, notify Engineer in writing for direction before proceeding.

7. Do not subject wire and cable to tension greater than that recommended by the cable manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

8. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

9. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties, kellem grip or similar approved devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

10. Where drawings specifically permit use of exposed cable installation in Plenum and/or Suspended Ceiling voids, conform to the following:
    a. Conform to EIA/TIA 569 with respect to separation from power and radio frequency (RF) sources. Provide at least twice the listed separation at fluorescent light fixtures, ballasts and similar high intensity EMF sources (including but not limited to motors, transformers and copiers).
    b. Support: Provide support for all cabling. Do not place or attach directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures.
        1) Provide supports at least 48” on center, with cables installed with slight sag to ensure conformance with EIA TSB40 tensioning and stress limits.
    c. Placement: Do not obscure access to access doors, hatches, air dampers, valves, cable trays, junction boxes, pull boxes or similar areas of access.
    d. Place EMT pipe sleeves at all wall penetrations. Fire stop sleeves and cables where penetrating a rated wall with an approved UL assembly.
11. Wiring practices
    a. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor’s option and at no additional costs to Owner, such terminals may be located in the equipment racks or in the terminal cabinets provided.
    b. Apply all crimp connectors only with manufacturer’s recommended ratchet type tooling and correct crimp dies for connector and wire size; pliers type crimp tooling shall not be acceptable.
    c. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer’s recommendations and make connections with automatic impact type tooling set to a recommended force.
    d. Make all connections to screw-type barrier blocks with insulated cirmp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to “Sharpie”.
    e. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
    f. Use only rosin core 60/40 tin/lead solder for all solder connections.
    g. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harness of different classes cross or where hinged panels are to be interconnected.
    h. Termination and build-out resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.
    i. Correct any and all of the following unacceptable wiring conditions:
        1) Deformed, brittle or cracked insulation.
        2) Torn or worn cable jacket.

3) Excessively scored cable jackets
4) Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
5) Cold solder joints.
6) Flux joints.
7) Solder splatter.
8) Ungrommeted, unbushed, or uninsulated wire or cable entries.
9) Deformation or improper radius of wire or cable.

12. Data cabling wiring practice (For copper cabling used in circuits of >1.0 Mbps conform to the following, in addition to the general requirements above.)
    a. Limit cable bends to a minimum radius of eight (8) times cable diameter except where otherwise noted herein.
    b. At junction boxes, form circular radius bends of eight times cable diameter minimum. Up to two (2) flat bends of 90° or less are permitted in any single cable run where necessary to accommodate field wiring conditions. Flat bends exceeding 90° will not be accepted.
    c. At the receptacle, a single bend of 90° or less and a 1 inch radius shall be permitted subject to the cable manufacturer certification of such an installation meeting Category 5E requirements. Contractor to field verify the performance of the proposed installation in a mockup using the proposed cabling, jacks, raceway and listed test equipment prior to proceeding.
    d. Tie wraps to be hand (not tool) tightened.
    e. Total run not to exceed 92 meters (300 feet). If condition exists report exceeded requirements to Engineer.
13. Labeling
    a. Provide permanent identification of run destination at all raceway terminations. Identify at each manhole, vault, handhole, terminal cabinet, pull box, equipment rack and receptacle/outlet.
    b. Unless otherwise noted, conform to the standards and methods of EIA/TIA 606.
    c. Identify all wire and cable clearly with permanent labels rapped about the full circumference within one (1) inch of each connection. Provide any of the following:
        1) Continuous permanent imprint; equivalent to Clifford of Vermont, Inc. "Quick-Pull".
        2) Direct hot stamp.
        3) Heat shrinkable factory hot stamped; equivalent to Bradysleeve Heatshrink.
        4) Adhesive strip printed labels wrapped the full circumference of the wire and sealed with clear heat shrink tubing; equivalent to Thomas Betts or Panduit Insta-code with clear heat-shrunk tubing equivalent to Alpha.
        5) Outside Plant, in Manholes or Pull Boxes. Panduit Fiber Optic Cable Marker Tags (Type PST-FO) or Lead tags, 2" square, drilled for cable attachment. Use

cable ties or THWN #12 or 2 #14 wrapped twice around the cable bundle and secure to tag using a crimp fastener.

d. Indicate:

1) Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.

2) Indicate installation date.

e. Terminal cabinet pull box and manhole, handhole, vault or similar locations subject to abuse, label in accordance to Section 16050.

1) Patching Bays and Jacks and Receptacles containing six or fewer jacks/outlets: Provide designation strip holders with clear plastic covers to retain replaceable designation strips. Provide designation strips with block lettering on permanent background in contrasting color. Use photographic print, laser print on acid free paper, plotting ink on Mylar, or equivalent non-fading process. Alternatively, provide black on white adhesive labels equivalent to those produced by Brother brand P-Touch Letter Machine. Embossed plastic (Dymo) labels shall not be acceptable. The presence of manufacturer provided silk screen iconic identification labels shall not relieve the contractor from the requirement to identify the receptacle with its associated cabling and circuit.

14. Signal grounding procedures

a. Where items specified in Section 16065 conflict with the requirements of this Section, the most stringent requirement shall govern.

b. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

c. Ground and bond equipment racks and similar equipment enclosures containing powered equipment exclusively to a telecommunication grounding bus bar.

d. At each rack, provide a lug bonded to the rack frame with a #10 Cu THWN stranded wire to the rack isolated ground bus.

e. Equipment signal ground shall be to racks isolated ground bus via the green wire of the equipment power cord. Where equipment uses an ungrounded power cord, provide #12 green bond wire to rack isolated ground bus bar. At equipment housing, provide crimp lug and suitable hardware for bonding.

f. Shielded cables of this section shall be grounded exclusively to a telecommunication grounding bus bar by a single path. Shield shall be tied to ground bar at one end only, i.e., at the low potential (receiving) end of run, unless otherwise noted.

3.03 FIELD QUALITY CONTROL

A. General

1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications closet wiring.

2. Test each end to end cable link.
3. Submit copy of final results on paper and in machine readable form, organized by circuit number, consistent with circuit numbering scheme used in preparing submittal drawings and in labeling receptacles and terminations.
    a. Submit machine-generated documentation and raw data of all test results on Contractor-provided, Owner approved forms; and in electronic format approved by the Owner.
    b. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the Owner with 1 licensed copy of the software.
    c. Provide registered testing software used for the actual tests to the Owner/Engineer for review of test data as may be required.

B. Station Wiring, General
1. Test station wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.
2. Correct any and all transpositions found, and retest.
3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced and retested.

C. Inside Cabling
1. Using a listed Category 6 cable test set, test and submit report on the parameters specified. Report whether tested link passes or fails the Category 5E standards outline within EIA/TIA-568.
2. Note exceptions to required Category standards. Remedy and retest.

D. Telephone: Outside Plant, Inside Riser Wire, Voice Station Wire (where not Category rated):
1. General
    a. A new cable shall be tested only after all wires within the cable have been terminated at both ends.
    b. For unshielded cable, “measurements to ground” means an electrical connection to the Telecommunications Ground Bus, building steel, electrical metallic conduit or a water pipe.
    c. The Contractor shall correct all defects possible.
    d. If the maximum number of un-repairable defective pairs exceeds 4% of the cable’s pair count, the cable shall be deemed unacceptable and shall be replaced. Replace, re-terminate and retest new cable at no additional cost to the Owner.
2. Test procedures
    a. Test #1 – Continuity:
        1) Meter set for 20Ω full scale ohm reading. Each pair shall be shorted at one end and the loop resistance value read at the other.

2) The difference between the largest and the smallest resistance reading from each pair in the cable shall be no more than 10 percent of the largest reading.

b. Test #2 – Balance, Polarity and Conductor Transpositions:

1) Upon passing Test #1, the tester at one end of cable shall ground tip side of each pair in turn. The tester at other end of cable reads resistance to building ground of same conductor.

2) Reading for each tip conductor in pair of approximately on-half of loop resistance value from Test #1.

3. Test Report

a. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions as well as corrective actions.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of clearing, grubbing, grinding, transporting, removing and disposing of trees, stumps, roots, vegetation debris, and existing improvements, including curb, gutters, catch basins, storm drains, landscaping, fencing, utilities, and other protruding obstructions within the clearing limits.

B. Protect trees, landscaping and shrubs that are not designated to be removed or near construction site that may be harmed by construction activities.

1.2 RELATED WORK

A. Section 02 41 00 – Demolition

B. Section 31 23 00 – Earthwork

C. Section 01 57 23 – Storm Water Pollution Prevention Plan

D. Section 01 57 27 – Dust Control

1.3 REGULATORY REQUIREMENTS

A. Obtain all required permits.

B. Dispose of removed materials in a legal manner at an approved disposal facility.

C. One hundred percent of trees, stumps, rocks and associated vegetation and soils resulting from land clearing shall be reused or recycled.

1.4 REFERENCES

A. Section 15 – Existing Facilities, State Standard Specifications

B. Section 19 – Earthwork, State Standard Specifications

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

A. Clear the specified areas by removing, above the natural ground surface, all existing improvements including curbs, gutters, catch basins, storm drains, landscaping fencing and utilities; vegetable growth such as trees, shrubs, logs, upturned stumps, roots of down trees, brush, and similar material.

1. Trees of 4-inch diameter and larger shall not be removed without Owner's authorization.

B. Grub the specified areas below the natural ground surface, except in embankment areas where the grading plane is two feet or more above the natural ground, to a depth necessary to remove all boulders, stumps, roots, buried logs, and other objectionable material including rock and concrete. Remove and stock pile the top 4 inches of topsoil in any area which is to receive structural fill.

3.2 PRESERVATION

A. If indicated or required, preserve trees, plants, rock outcroppings, or other features designated to remain. Protect trees and plants from damage; fell trees in a manner which shall not injure standing trees, plants and improvements which are to be preserved.

3.3 SALVAGE EQUIPMENT

A. Salvaged equipment shall be delivered to the Owner at a designated site.

B. Equipment to be salvaged is designated in Section 02 41 00 – Demolition.

END SECTION

SECTION 31 22 19

FINISH GRADING

PART 1 GENERAL

1.1 WORK INCLUDED

A. All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.2 RELATED WORK

A. Section 31 23 00 – Earthwork

B. Section 01 57 23 – Storm Water Pollution Prevention Plan

C. Section 01 57 27 – Dust Control

D. Section 32 93 00 – Trees, Plants and Ground Cover

1.3 REFERENCES

A. Section 19 – Earthwork, State Standard Specifications

1.4 QUALITY ASSURANCE

A. Relative Compaction:

1. Owner shall pay for all compaction tests.

B. Tests for compaction shall conform to references listed in Part 1.3 of this section

C. Sample backfill materials per ASTM D75.

D. Compaction testing will be performed in accordance with Section 19-5.03, State Standard Specifications.

1. Test every 10,000 square feet of engineered fill or aggregate base material placed.

E. Where compaction tests indicate failure to meet the specified compaction, the Contractor will rework the entire failed area until the specified compaction has been achieved at his sole expense.

PART 2 PRODUCTS

2.1 MATERIALS

A. Soil:

1. Original surface soil typical of the area.

2. Capable of supporting native and specified plant growth.

PART 3 EXECUTION

3.1 SURFACE FINSH WORK

A. Grade all disturbed areas, blending with adjacent terrain. Minor irregularities will be permitted.

1. Bring all sub-grades to specified contours, even and properly compacted.

B. Remove all stones and debris over two inches in any dimension.

C. Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.

D. Clean Up: Remove all rubbish and excess material for disposal as approved, and leave area in a neat, satisfactory condition.

3.2 TOLERANCES

A. Prior to placing subsequent layers of material thereon, the grading plane shall conform to one of the following:

1. Finish Grading Tolerance: ±0.10 foot from required elevations

2. When subbase of base material to be placed on the grading plane is to be paid for by the ton, the grading plane at any point shall not vary more than 0.10 FT. above or below the design grade established by the Engineer.

3. When the material to be placed on the grading plane is to be paid for by the cubic yard, the grading plane at any point shall be not more than ±0.05 foot above the design grade established by the Engineer.

4. When asphalt concrete or asphalt concrete base is to be placed on the grading plane, the grading plane at any point shall not vary more than ±0.05 foot from the design grade established by the Engineer.

3.3 ACCEPTANCE

A. Upon completion, obtain Engineer’s acceptance of grade and surface.

END SECTION

SECTION 31 23 00

EARTHWORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. All earthwork performed under this contract shall conform to the General Requirements set forth in this section, except as otherwise specified in other sections.

B. Excavate earth and rock as necessary to allow the installation or construction of various items of work, regardless of character and subsurface conditions.

C. Haul, place, rough grade, compact, and finish grade excavated material as engineered fill on those portions of the project site where it is necessary in order to construct the facilities indicated on the Plans.

D. Dispose of unsuitable material off-site or in designated areas, as directed by the Engineer.

E. Prepare excavation and fill for compaction testing.

1.2 RELATED WORK

A. Section 31 11 00 – Clearing and Grubbing

B. Section 31 22 19 – Finish Grading

C. Section 31 23 31 – Compacting Earth Materials

1.3 REFERENCES

A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

3. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.

B. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

C. ASTM D75 Standard Practice for Sampling Aggregates

D. ASTM D6938 – Density of soil and base rock in place by Nuclear method.

E. ASTM D2937 – Density of soil and in place by Tube method.

F. Section 26 – Aggregate Bases, State Standard Specifications.

G. Section 15 – Existing Facilities, State Standard Specifications

H. Section 18 – Dust Palliatives, State Standard Specifications

I. Section 19 – Earthwork, State Standard Specifications

J. *Geotechnical Engineering Investigation* entitled*, Geotechnical Engineering Investigation Report Proposed Well 38 Treatment* by BSK Associates, dated December 18, 2019.

1.4 PROTECTION

A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.

1. Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P – Excavations, CAL/OSHA requirements, and the Contract Documents.

B. Notify Engineer of unexpected subsurface conditions.

C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

D. Grade excavation top perimeter to prevent surface water run-off into excavation.

1.5 CONTROL AND DIVERSION OF WATER

A. The Contractor shall perform control of water operation in accordance with Section 31 23 21- Dewatering.

B. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.

C. Plan – Prior to beginning any work on the removal of water from foundations, the Contractor shall submit for the Engineer's approval a water control plan showing his proposed method for the removal of water from foundations and other parts of the work.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 - Submittals.

B. Submit plans as required for worker protection against caving ground in excavation. Designs for shoring, bracing, sloping, or similar provisions shall bear the seal of a registered civil or structural engineer licensed to practice in the State of California.

1.7 QUALITY ASSURANCE

A. Compaction Testing:

B. Compaction tests will be performed for each lift or layer.

C. Tests for compaction shall conform to references listed in Part 1.3 of this section

D. Sample backfill materials per ASTM D75.

E. Compaction testing will be performed in accordance with State Standard Specifications, Section 19-6.03.

1.8 DEFINITION

A. Unsuitable Material: Unsuitable material is material determined to be:

1. Impossible to compact to specified density using ordinary methods at optimum moisture content.

2. Material containing trash, debris, oversized material or other foreign and objectionable materials.

3. Incapable of being compacted to Specified density using ordinary methods at optimum moisture content.

4. Too wet to be properly compacted if circumstances prevent satisfactory in-place drying prior to incorporation into the work.

5. Non-native material containing a significant amount of permeable materials, such as sand or rock, that cannot be blended with other material and requires to be off hauled.

6. Expansive clays that cannot be mixed or treated and requires to be off hauled.

7. Otherwise unsuitable for the planned use.

1.9 PROJECT CONDITIONS

A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.

B. Arrange construction sequences to provide the shortest practical time that trenches will be open to avoid hazard to the public, and to minimize the possibility of trench collapse.

C. Obtain all required permits and licenses before installing utilities and follow the rules and requirements of the authority having jurisdiction.

1.10 EXCAVATION CLASSIFICATION

A. Regardless of the nature of material excavated, all excavation will be considered unclassified.

1.11 HAND EXCAVATION

A. Hand excavation will be required within the drip line of selected trees. The Engineer will designate these trees and will direct the performance of said hand excavation.

B. Unless directed by the Engineer, roots two inches in diameter or larger shall not be cut.

PART 2 PRODUCTS

2.1 GENERAL

A. All backfill material shall be approved before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items.

B. Engineered fill materials for all fill areas shall be as required by State Standard Specifications, Section 19-6.

C. Gravel: Pit run, natural stone; free of shale, clay friable materials and debris; graded in accordance with 1 ½" x ¾" aggregate grading in State Standard Specifications Section 90-1.02C (4).

D. Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; No. 8 minimum to 3/8" maximum size per SSS Section 90-10C(4)(a).

E. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with State Standard Specifications Section 90-1.02C (4)(c).

F. Imported sand shall have a sand equivalent of 30 per ASTM D2419.

G. Permeable material for use in backfilling under, around, and over underdrains; and permeable material for chimney drains, riprap bedding, or other subdrainage purposes shall consist of hard, durable, clean sand, gravel or crushed stone and shall be free from organic materials, clay balls, or other deleterious substances which meets State Standard Specification Section 68-2.02, Class 2.

2.2 UTILITY LINE MARKING

A. As specified in Section 33 05 26 - Utility Line Marking.

2.3 MATERIALS FOR TRENCH BACKFILLING

A. Refer to Section 31 23 17– Trenching Backfilling and Compacting.

PART 3 EXECUTION

3.1 GENERAL

A. All fill and disturbed surfaces shall be compacted to a minimum of 90 percent relative compaction unless noted otherwise.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 MOISTURE CONTROL

A. Water development, hauling, and application shall be in accordance with State Standard Specifications Section 10-6, Watering.

3.4 EXCAVATION

A. Excavate the specified areas as shown on the Plans.

B. If the Plans require placement of fill prior to pipe, or structure excavation, the fill shall first be constructed to the design grade shown for a distance each side of the pipe or structure of not less than five times the diameter of the pipe or the width of the structure after which the trench shall be excavated and the pipe or structure installed.

C. Paved Areas: Cut existing pavement to full depth to a true line before excavation and maintain the edge suitable for repaving. Pavement removed shall not be used as backfill.

3.5 ENGINEERED FILL AND EMBANKMENT CONSTRUCTION

A. Unless otherwise noted, placement and compaction of engineered fill materials for all fill areas shall be performed according to the provisions of the State Standard Specifications, Section 19-6. Section 19-6.02A shall be amended to say that large rocky material or hard lumps large than three inches in greatest dimension will not be allowed.

B. Before placing embankment, scarify ground surface to provide ample bond between old and new material, as shown on the Plans. Place embankment material in layers not exceeding eight inches, loose measurement.

C. Compaction shall be in accordance with State Standard Specifications, Section 19-5. Compact each layer before placing the next layer. As the compaction of each layer progresses, continually level and manipulate to ensure uniform moisture and density. Add water to obtain optimum moisture content. Removal of excess water shall be accomplished through aeration by plowing, blading, disking, or other methods satisfactory to the Engineer.

3.6 EXCAVATION FOR BUILDINGS, CONCRETE TANKS AND OTHER CONCRETE STRUCTURES

A. Refer to Section 31 23 19 – Structure Excavation & Backfilling.

3.7 TRENCH EXCAVATION AND BACKFILLING

A. Refer to Section 31 23 17 – Trenching, Backfilling, and Compacting.

3.8 UTILITY INSTALLATION

A. Install utility marking as specified in section 33 05 26 - Utility Line Marking.

B. Utility Installation: Shape the trench bottom to ensure uniform contact with the full length of the installed line and remove any sharp-edged materials that might damage the line. Compaction shall be maintained beneath the line.

3.9 SAND CEMENT SLURRY, CONCRETE ENCASEMENT AND THRUST BLOCKS

A. Concrete

1. Place as shown on the Plans and in accordance with Section 03 30 00 - Cast-In-Place Concrete.

B. Slurry Cement

1. Slurry Cement is also referred to as Controlled Low Strength Material (CLSM).

2. Place as shown on the plans and in accordance with State Standard Specifications, Section 19-3.03F.

3.10 CONTROL OF WATER

A. The contactor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering of excavations. The contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand by pumps for use in case other pumps become inoperable

B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.

C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.

D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.

E. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the owner.

F. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.

3.11 SURPLUS MATERIAL

A. Unless otherwise specified, surplus excavated material shall be used to widen embankments uniformly or to flatten slopes.

B. All surplus material shall be exported from the site.

3.12 SHORING AND SHEETING

A. Construct and maintain all shoring, sheeting, and slope layback necessary to protect the excavation, as needed, for the safety of the employees and as required by applicable State and Federal laws. Provide suitable barricades for public safety, regardless of trench depth.

3.13 DEWATERING

A. Refer to Section 31 23 21.

3.14 UNSUITABLE MATERIAL

A. Unsuitable material shall be excavated and disposed of in a lawful manner off the project site in accordance with Section 31 23 35 - Disposal of Materials. All disposal shall be approved by the Engineer prior to initiating the work.

3.15 SURFACE FINISH WORK

A. Paved Areas: Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent paved areas. Saw cut pavement edges to a true line and broom as needed prior to repaving.

B. Open Areas: Grade all disturbed areas, blending with adjacent terrain. Minor irregularities will be permitted.

C. Drainage Ditches: Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.

D. Clean Up: Remove all rubbish and excess material for disposal as approved, and leave area in a neat, satisfactory condition.

3.16 TOLERANCES

A. Tolerances are defined as allowable variations from specified lines, grades, and dimensions. The intent of this paragraph is to establish tolerances that are consistent with modern construction practice, yet are governed by the effect that permissible variations may have upon the construction.

B. Variations from specified lines, grades, and dimensions:

Variation in elevation for invert of roads from those specified	±0.10 foot
Variation from specified width of section at any height	±0.25 foot

C. Variation is defined as the distance between the actual dimension and grade of the alignment and the specified position in plan for the alignment. Plus or minus variations indicate a permitted actual position up or down and in or out from the specified position in plan. Variations not designated as plus or minus indicate the maximum deviation permitted between designated successive points on the completed element of construction.

END SECTION

SECTION 31 23 17

TRENCHING, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes material, testing, and installation for trench excavation, backfilling and compacting.

1.2 RELATED WORK

A. Section 31 11 00 – Clearing and Grubbing

B. Section 31 23 00 – Earthwork

C. Section 40 05 00 – Pipe and Fittings

1.3 REFERENCES

A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Sol-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.

C. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

D. ASTM D6938 – Density of soil and base rock in place by Nuclear method.

E. ASTM D2937 – Density of soil and in place by Tube method.

F. Section 26 – Aggregate Bases, State Standard Specifications.

G. Geotechnical Engineering Investigation entitled, Geotechnical Engineering Investigation Report Proposed Well 38 Treatment, dated December 18, 2019.

1.4 SUBMITTALS

A. Submit plans as required for worker protection against caving ground in excavations. Submittals shall be in accordance with Section 01 33 00 – Submittals Procedures.

1.5 PROTECTION

A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.

1. Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P—Excavations, CAL/OSHA requirements, and the Contract Documents.

B. Notify Engineer of unexpected subsurface conditions.

C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

D. When the pipe laying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals or foreign material to enter the pipe.

1.6 CONTROL AND DIVERSION OF WATER

A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.

B. Plan – Prior to beginning any work on the removal of water from trenches, the Contractor shall submit for the Engineer's approval a water control plan showing his proposed method for the removal of water from trenches and other parts of the work.

C. Dispose of the water in a manner that will prevent damage to the adjacent property and in accordance with regulatory requirements.

D. Do not drain trench water through the pipeline under construction.

1.7 PROJECT CONDITIONS

A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.

B. Obtain all required permits and licenses before installing utilities and follow the rules and requirements of the authority having jurisdiction.

C. Arrange construction sequences to provide the shortest practical time that the trenches will be open to avoid hazard to the public, and to minimize the possibility of trench collapse

PART 2 MATERIALS

2.1 NATIVE EARTH BACKFILL

A. Native earth backfill used above the pipe zone shall be fine-grained materials free from roots, debris, and rocks larger than 3 inches.

2.2 MATERIALS FOR TRENCH BACKFILLING

A. Furnish required bedding, select backfill and backfill materials listed under the appropriate types of utility line in the sections to which this work relates.

B. All fill material will be subject to the approval of the Engineer.

C. Materials used in backfill, as shown in trench details, are defined as follows:

1. Bedding: When rock, unstable material, or wet trench is encountered at the excavated grade for utility installation, bedding is required. Materials shall be predominantly sand and gravel, having a Plasticity Index less than 6.

   a. Gradation as follows:

Sieve Size	Percent Passing
½ inch	100
No. 4	50-80
No. 200	10-25

   b. Bedding material shall have a Sand Equivalent of 30, per ASTM D2419.

2. Bedding may be omitted if, in the opinion of the Engineer, the excavated trench bottom will adequately support and not damage the utility line.

3. Select Backfill: Materials shall be predominantly sand and gravel, having a Plasticity Index less than 6.

   a. Gradation as follows:

Sieve Size	Percent Passing
1½ inch	100
No. 4	50-80
No. 40	10-25

   b. Select backfill material shall have a Sand Equivalent of 30 per ASTM D2419.

4. Backfill: Soils that contain no rock larger than three inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed with non-cohesive soils.

2.3 SELECT AND IMPORT MATERIAL IN PIPE AND BEDDING ZONE

A. Gravel: Pit run, natural stone; free of shale, clay, friable materials and debris; graded in accordance with 1½" x ¾" aggregate grading in Section 90-3, State Standard Specifications.

B. Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; 1/4-inch minimum to 5/8-inch maximum size.

C. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with Section 90-3, State Standard Specifications, within the following limits:

Sieve Size	Percent Passing By Weight
No. 4	75 – 100
No. 200	0 - 10

D. Imported sand shall have a sand equivalent of 30 per ASTM D2419.

2.4 SAND-CEMENT SLURRY

A. Sand-cement slurry backfill shall be as specified in Section 03 30 10 – Cast-in-Place Concrete.

2.5 WATER FOR COMPACTION

A. Water shall be free of organic materials injurious to the pipe coatings, have a pH of 7.0 to 9.3, maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l.

PART 3 EXECUTION

3.1 GENERAL

A. Excavation and backfilling of trenches used for construction of communications, power, process piping, and water distribution and sewer systems shall conform to State Standard Specifications, Section 19, Earthwork.

B. Excavation shall be by open cut except that short sections of a trench may be tunneled if the utilities can be safely and properly installed and backfill can be properly compacted in such tunnel sections.

3.2 INSPECTIONS

A. Verify stockpiled material has been approved for reuse.

B. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.3 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.4 AC PAVEMENT AND CONCRETE REMOVAL

A. Cut bituminous and concrete pavements, regardless of the thickness, curbs, gutters and sidewalks prior to excavation of trenches.

1. Width of material removed shall be at least equal to the required width of the trench at ground surface.

2. Width of material removed shall be as shown on the Plans

3. AC pavement and concrete rubble shall not be used for trench backfill.

3.5 TRENCH EXCAVATION

A. Excavate the trench to the lines and grades shown on the Drawings for storm sewer, sanitary sewer, water, and other utilities and points of connection, with allowance for pipe thickness, sheeting and shoring if used, and for special bedding.

B. Paved Areas: Cut existing pavement to full depth to a true line before excavation and maintain the edge suitable for repaving. Pavement removed shall not be used as backfill.

C. Trenching Guidelines: Excavate the trench to the approximate level of the grade of the utility line to be installed, using adequate trench width and side slopes to safely accommodate worker access.

1. Rocky Trench Bottom: Where ledge rock, hard pan, boulders, or sharp-edged materials are encountered, over excavate a minimum depth of 6 inches below the bottom of the utility exterior wall to permit adequate bedding preparation. The installed utility shall have at least 6 inches of clearance from any rock protrusion.

2. Unstable Trench Bottom: Secure approval of depth of over-excavation and stabilization method. For wet trench construction, use approved method of dewatering through diversion, damming and pumping, well points, or underdrain systems. Dispose of removed fluidized materials as approved. Use bedding material to build a suitable foundation to within 6 inches of finished utility grade, prior to bedding with the specified material. Compact layers to 95 percent of maximum density in not greater than 6-inch layers. Do not proceed with utility installation until wet trench and unstable conditions are corrected to the satisfaction of the Engineer.

D. Remove areas of sub-grade not readily capable of it-situ compaction.

1. Backfill with Bedding or Select Backfill material and compact to density equal to requirements for subsequent backfill.

E. Correct unauthorized excavation at no cost to Owner.

1. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade.

2. Place the refilling material over the full width of trench in compacted layers not exceeding eight inches deep to the established grade with allowance for special bedding.

F. Trench widths in the pipe zone shall be as shown on the drawings. If no details are shown, maximum width shall be 24 inches greater than the pipe outside diameter.

1. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least two feet between the top edge of the trench and the structure or footing.

G. Hand trim for bell and spigot pipe joints.

H. Remove lumped soil, boulders and rock.

I. Excavation shall not interfere with normal 45 degree bearing splay of foundations.

J. During trench excavation, place the excavated material only within the working area. Do not obstruct roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

K. Foundation stabilization

1. After the required excavation has been completed, the Engineer will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unsuitable materials exist at the exposed subgrade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a width 24 inches greater than the pipe outside diameter and to the depth required.

3.6 LENGTH OF OPEN TRENCH

A. Limit the length of open trench to 300 feet in advance of pipe laying or amount of pipe installed in one working day.

B. Complete backfilling, temporary or first layer paving, not more than 300 feet in the rear of pipe laying operation.

3.7 TRENCH EXCAVATION IN EMBANKMENT AREAS

A. Construct and compact the embankment to an elevation one foot, minimum, over the top of the largest pipe or conduit to be installed prior to trench excavation.

3.8 UNSUITABLE MATERIAL

A. Unsuitable material shall be excavated and disposed of in a lawful manner off the project site, all disposal shall be approved by the Engineer prior to initiating the work.

3.9 DEWATERING

A. The Contractor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering of excavations. The Contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand-by pumps for use in case other pumps become inoperable.

B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.

C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.

D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.

E. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the Owner.

F. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.

3.10 TRENCH BACKFILLING

A. Support pipe during placement and compaction of bedding fill.

B. Backfilling and cleanup work shall be accomplished as sections of pipe or conduit are tested and approved. Vehicular travel through the work site shall be impeded or obstructed as little as possible.

C. Compaction: Use vibratory compactors for sands and gravels (non-cohesive soils). Use mechanical tampers for sand and gravel containing a significant portion of fine-grained materials, such as silt and clay (cohesive soils). Hand tamp around pipe or cable to protect the lines until adequate cushion is attained. Puddling or water flooding for consolidation of backfill or compaction by wheel rolling will not be permitted.

D. Bedding: Unless otherwise specified, compact the specified material to 95 percent of maximum density to the finished utility grade.

E. Select Backfill: Fill by hand placement around the utility to just over half depth, and compact in a manner to ensure against lateral or vertical displacement. Place

select backfill to 12 inches above the utility line by hand placement in not more than 6-inch layers.

F. Backfill: To minimize settling, soils shall be backfilled in layers, with each layer compacted prior to addition of the next layer. Unless otherwise specified, place and compact the specified material as follows:

1. Vehicular Traffic Areas: Fill and compact in 8-inch maximum layers as follows:

a. From top of select backfill to two feet below top of subgrade, compact to 90 percent of maximum density.

b. From two feet below top of subgrade to top of subgrade, compact to 95 percent of maximum density/

2. Non-traffic Areas: Fill and compact in 8-inch maximum layers to 90 percent of maximum density.

G. Employ a placement method that will not disturb or damage pipe or utilities.

H. Maintain optimum moisture content of backfill materials to attain required compaction density.

I. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

J. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

1. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe.

2. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

K. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side.

L. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, and other structures.

M. Do not permit free fall of the material until at least two feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.

N. Remove surplus backfill materials from site.

O. Leave stockpile areas completely free of excess fill materials.

3.11 TOLERANCES

A. Top Surface of Backfilling: ±0.1 foot.

3.12 SAND CEMENT SLURRY, CONCRETE ENCASEMENT AND THRUST BLOCKS

A. Place in accordance with the Contract drawings.

3.13 COMPACTION REQUIREMENTS

A. Relative compaction requirements shall be as shown on the Plans.

END SECTION

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SECTION 31 23 19

STRUCTURE EXCAVATION & BACKFILLING

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of excavation and backfill for concrete structures, and preparation of subgrade for concrete flatwork.

B. Haul, place, rough grade, compact, and finish grade excavated material as engineered fill on those portions of the project site where it is necessary in order to construct the facilities indicated on the Plans.

C. Dispose of unsuitable material off-site or in designated areas, as directed by the Engineer.

1.2 RELATED WORK

A. Section 31 23 00 – Earthwork

B. Section 31 23 17 – Trenching Backfilling and Compacting

C. Section 31 22 19 – Finish Grading

D. Section 01 57 23 – Storm Water Pollution Prevention Plan

E. Section 01 57 27 – Dust Control

F. Section 03 33 10 – Concrete Site Work

1.3 REFERENCES

A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Sol-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop. (Curve)

C. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

D. ASTM D6938 – Density of soil and base rock in place by Nuclear method.

E. ASTM D2937 – Density of soil and in place by Tube method.

F. Section 25 – Aggregate Subbases, State Standard Specifications

G. Section 26 – Aggregate Bases, State Standard Specifications.

1.4 SUBMITTALS

A. Submit plans as required for worker protection against caving ground in excavations. Submittals shall be in accordance with Section 01 33 00 – Submittals Procedures.

1.5 SAMPLES

A. Submit 10 lb sample of each type of fill to testing laboratory, in airtight containers.

1.6 QUALITY ASSURANCE

A. Compaction Testing

B. Compaction tests will be performed for each lift or layer.

C. Tests for compaction shall conform to references listed in Part 1.3 of this section

D. Sample backfill materials per ASTM D75.

E. Compaction testing will be performed in accordance with Section 19, State Standard Specifications.

1. Test every structure location.

F. Where compaction tests indicate failure to meet the specified compaction, the Contractor will rework the entire failed area until the specified compaction has been achieved.

G. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

1.7 DEFINITION

A. Unsuitable Material: Unsuitable material is material determined to be

1. Incapable of being compacted to specified density using ordinary methods at optimum moisture content.

2. Too wet to be properly compacted if circumstances prevent satisfactory in-place drying prior to incorporation into the work.

3. Otherwise unsuitable for the planned use.

1.8 PROTECTION

A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.

B. Notify Engineer of unexpected subsurface conditions

C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

D. Grade excavation top perimeter to prevent surface water run-off into excavation.

1.9 CONTROL AND DIVERSION OF WATER

A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.

1.10 CLASSIFICATION

A. Expected material that will be excavated at this site has been identified in the Geotechnical Report.

B. Regardless of the nature of material excavated, all excavation will be considered unclassified.

1.11 SITE CONDITIONS

A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.

PART 2 PRODUCTS

2.1 SELECT BED AND FILL MATERIALS

A. Conform to Section 31 23 17, Trenching, Backfilling, and Compacting.

2.2 SELECT MATERIAL

A. Gravel: Pit run, natural stone; free of shale, clay, friable materials and debris; graded in accordance with 1½" x ¾" aggregate grading in Section 90-1.02C, State Standard Specifications.

B. Pea Gravel: natural stone; washed, free of clay, shale, organic matter; ¼ inch minimum to ⅝ inch maximum size.

C. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with ANSI/ASTM C136 within the following limits:

Sieve Size	Percent Passing
No. 4	75-100
No. 200	0-10

D. Class 2 Aggregate Base: material as specified for ¾" maximum grading in the State Standard Specifications, Section 26.

2.3 CONCRETE SLURRY

A. Concrete slurry mix shall be as specified in Section 03 30 10, Cast in Place Concrete.

2.4 ENGINEERED FILL MATERIAL

A. Native granular soil materials may be used as engineered fill. Pulverized asphalt concrete or Portland cement concrete may be incorporated into engineered fill provided no rock pockets or voids are produced. Particles larger than three inches shall be removed from trench backfill, particles larger than six inches shall be removed from engineered fill.

B. All imported fill material placed in structural areas shall consist of predominantly granular soil that is non-expansive, and shall be approved by the Engineer prior to use.

1. The R-value of the imported fill material shall be at least 50.

2.5 GRANULAR BACKFILL/AGGREGATE BASE COURSE

A. Granular backfill and aggregate base course shall meet the requirements of State Standard Specifications, Section 26, Class 2 aggregate base, ¾ inch maximum.

B. Material from concrete crushing operations may be used as granular backfill provided it meets the above requirements.

2.6 WATER

A. Water development, hauling, and application shall be in accordance with the State Standard Specifications, Section 10-6, Watering.

PART 3 EXECUTION

3.1 GENERAL

A. Provide required shoring, sheeting, and slope layback necessary to protect the excavation, as needed, for the safety of the employees and as required by applicable State and Federal laws. Provide suitable barricades for public safety, regardless of trench depth.

B. Upon completion of excavation and before placing forms or structures, notify the Engineer who will inspect the excavation and may take tests to determine soil-bearing values.

C. Identify required lines, levels, contours, and datum.

1. Stake and identify the extent of all earthwork operations prior to starting work.

D. Use suitable material removed from excavation before importing backfill.

E. Verify that stockpiled fill to be reused is approved by the Engineer.

F. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.2 DEWATERING

A. The Contractor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering of excavations. The Contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand-by pumps for use in case other pumps become in-operable.

B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.

C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.

D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.

E. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.

F. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the Owner.

3.3 EXCAVATION

A. Carefully excavate to the established lines and grades shown on the drawings, or as revised and approved by the engineer, to provide a firm, uniform, and unyielding foundation for the proposed structures.

B. Excavations for all footings, piers, finished walls and grade beams shall be sufficiently large so that forms for concrete may be properly placed, removed, and inspected.

1. Excavation for footings may be made to the net footing size plus two inches if the earth banks are sufficiently stable to remain in position until the concrete is in place and if approved by the Engineer.

C. The bottoms of footings, piers, slabs, walls, and grade beams to receive concrete shall be level before placing concrete. All foundations shall rest on firm bearing in undisturbed soil, or on controlled compacted fill.

1. The exposed subgrade surface shall be scarified to a depth of 8 inches, conditioned to optimum moisture content and compacted to at least 95 percent of the maximum dry density.

D. If any existing foundations, roots, stumps, debris, waste materials, pipes, or similar items have been removed, the Contractor shall excavate below these portions to solid undisturbed earth and foundations in these areas shall be built to necessary levels.

E. If soil conditions in excavations are not in accordance with the geotechnical report and seem to indicate that footings need not be carried down as deep as shown, or must be carried deeper, the changes shall be made by the Contractor after approval by the Engineer.

1. Over excavation shall be required a minimum of two feet below top of proposed slab grades under all structures, including but not limited to the tank, tank ring wall, all concrete slabs, etc., unless shown otherwise on the Plans.

2. Engineered fill in over excavated areas shall be import fill material, free from organic materials or deleterious substances.

F. Common Fill Material (native material) is not acceptable for use as Engineered fill under any structure, tank, tank ring wall, or concrete slab.

3.4 SURPLUS MATERIAL

A. Unless otherwise specified, surplus excavated material shall be used to widen embankments uniformly or to flatten slopes, or it shall be disposed of in a uniform manner along the adjacent roadway around the site or otherwise as approved.

B. Unless otherwise specified, surplus excavated material shall be used as fill for other areas requiring fill as shown on the Plans. Excess material that is not needed for engineered fill may be disposed of at an off-site spoil area. The location of the off-site spoil area, the limits of the fill area, the depths of fill, and the manner of work shall be as directed by the Engineer.

C. Stockpile surplus material as shown on the plans and/or as directed by the Engineer

D. Leave stockpile areas completely free of excess fill materials.

3.5 UNSUITABLE MATERIAL

A. Unsuitable material shall be excavated and disposed of in a uniform manner off the project site, within the Owner's property as approved, however all disposal shall be approved by the Engineer prior to initiating the work.

3.6 OFF-SITE BORROW AREAS

A. Engineered fill material may be obtained from off-site borrow areas, if on-site sources prove to be insufficient.

3.7 BACKFILLING

A. Unless otherwise shown in the Plans, all backfill shall conform to Section 19-3 of the State Standard Specifications.

B. Do not place backfill against concrete until concrete has cured sufficiently to accept the load as determined by Section 19-3.03E of the State Standard Specifications.

C. Place and compact common fill material in continuous layers not exceeding eight inches loose depth.

D. Employ a placement method so not to disturb or damage pipes or utilities.

E. Maintain optimum moisture content of backfill materials to attain required compaction density.

F. Remove surplus materials from site.

3.8 TOLERANCES

A. Top Surface of Backfilling: ±0.1 foot from design grade.

3.9 SLURRY CEMENT

A. Slurry cement backfill shall be placed and shown on the Drawings and in accordance with State Standards Specifications, Section 19-3.02E.

END SECTION

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SECTION 31 23 21

DEWATERING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes designing, furnishing, installing, operating, maintaining, and removing a dewatering system. The system shall be of sufficient size and capacity to maintain a dry condition for construction of each part of the work without delaying construction operations. Control all water regardless of source. Comply with applicable environmental protection laws and requirements in operation of the dewatering system.

1.2 RELATED WORK

A. Division 31

1.3 DATA AVAILABLE

A. Logs of test borings, test pits, and trench excavations performed are shown in the geotechnical report. The subsurface conditions from the test borings and excavations apply only to the locations of the borings and at the times of the explorations. The subsurface conditions elsewhere at the site and at the time of construction may be different.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit information on the proposed type of dewatering system including the arrangement, location and depths of system components.

C. Complete description of equipment and instrumentation to be used with installation including operation and maintenance procedures.

D. Type and sizes of desiltation equipment.

E. Method of disposal of pumped water.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Review and evaluate the available subsurface data for the project site with respect to required dewatering facilities, including any additional groundwater monitoring data required.

B. Provide means and devices to remove promptly and dispose of water entering excavations and keep the bottoms of the excavations firm and free of standing water and side slopes stable until the pipeline or structures to be constructed are completed and/or the backfill to be placed therein has been placed.

C. Perform the pumping and dewatering operations such that no disturbance to the bearing soil or to soil supporting any other work will result from the dewatering operations. The dewatering discharge shall not cause siltation or other negative environmental impact on natural waterways or other property; such discharge shall be in accordance with applicable federal, state, and local regulations.

D. Operate the dewatering system continuously to prevent flotation of partially completed pipelines, structures or other work and flooding/excess wetting of work areas.

3.2 DEWATERING REQUIREMENTS

A. Design, furnish, install, maintain, and operate a dewatering system which shall prevent loss of fines, boiling, quick conditions, or softening of foundation strata and maintain stability of bottoms of excavations so that every phase of the work can be performed in the dry with the exception of dredging. Prior to placement of concrete or pipe the subgrade shall be in a firm, well drained condition and of adequate and uniform load bearing nature to support construction personnel, materials, equipment and reinforcing steel mats without tracking, rutting, heaving or settlement. All soft, saturated or otherwise unsuitable material shall be removed and replaced with approved backfill.

B. Water levels shall be a minimum of 2 feet below subgrade until all backfill is placed and compacted.

3.3 INSTALLATION AND OPERATION

A. The location of every element of the dewatering system shall be such that interference with excavation and construction activity is minimized.

B. Demonstrate to the Owner’s Representative that the dewatering system meets the specified requirements.

C. When the dewatering system does not meet the specified requirements and, as a consequence, loosening or disturbance of the foundations strata, instability of the slopes, or damage to the foundations or structures occurs, provide materials, labor, and work for restoration of foundations soil, fill soils, slopes, foundations, or structures at no cost to the Owner.

D. When the dewatering system does not meet the specified requirements and consequently fill surfaces become too wet or the fill exceeds the specified moisture content, remove and replace the upper materials with materials placed and compacted to the specifications. Do not dry out overly wet fills resulting from failed or inadequate dewatering systems or mix with dry material and rework in-place to meet applicable fill specifications.

3.4 STANDBY EQUIPMENT

A. Provide standby pumping and power equipment of sufficient capacity to maintain the dewatering system in an operable condition in the event of failure of any of the original equipment or power.

3.5 DAMAGES

A. The Contractor shall be responsible for and shall repair without cost to the Owner any damage to work in place, other contractors' equipment, and the excavation, including damage to the bottom of the excavation due to heave and removal of material and pumping out of the excavated area that may result from the Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.

3.6 REMOVAL

A. Remove the components of the dewatering system from the site at the completion of the dewatering work.

END SECTION

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SECTION 31 23 31

COMPACTING EARTH MATERIALS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide all labor, materials and equipment and perform all operations necessary to complete all earthwork required as specified, shown on the drawings, or as directed.

1.2 RELATED WORK

A. Section 01 57 23 – Storm Water Pollution Prevention Plan

B. Section 01 57 27 – Dust Control

C. Section 03 33 10 –Concrete Site Work

D. Section 31 11 00 – Clearing and Grubbing

E. Section 31 22 19 – Finish Grading

F. Section 31 23 00 – Earthwork

G. Section 32 11 23 – Aggregate Base

1.3 REFERENCES

A. ASTM D75 – Practice for Sampling Aggregates.

B. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

C. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.

D. ASTM D1556 – Density and Unit Weight of Soil in Place by Sand-Cone Method.

E. ASTM D2419 – Sand Equivalent Value of Soil and Fine Aggregate

F. ASTM D6938 – Density of Soil and in Place by the Drive Cylinder Method.

G. ASTM D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

H. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

I. ASTM D5080 – Standard Test Method for Rapid Determination of Percent Compaction

J. ASTM D6938 – In Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth).

K. ASTM D7382 - Standard Test Methods for Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer

L. Section 26 – Aggregate Bases, State Standard Specifications.

M. Section 16 – Clearing and Grubbing, State Standard Specifications

N. Section 17 – Watering, State Standard Specifications

O. Section 19 – Earthwork, State Standard Specifications

P. *Geotechnical Engineering Investigation* entitled*, Geotechnical Engineering Investigation Report Proposed Well 38 Treatment* by BSK Associates, dated December 18, 2019.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 - Submittal Procedures.

1.5 QUALITY CONTROL

A. In-Place Density:

1. Compacted backfill for structures and structure foundations: At least one test per lift or per 500 cubic yards placed, whichever is more frequent.

2. Subgrade preparation including scarification and re-compaction of native soils: At least 1 test per lift per 1,000 sf of surface area or 500 cubic yards of fill placed, whichever is more frequent

3. Embankments and building pads: At least 1 test per lift per 1,000 sf of surface area or every 200 lineal foot of embankment, or 2000 cubic yards of fill placed, whichever is more frequent.

4. Pipeline Trenches: At least 1 test per lift per every 200 feet of trench backfill placed or every 500 cubic yards placed, whichever is more frequent.

5. A greater frequency of testing may be required at the start of work or when new materials, crews, or equipment are introduced to the site. A lesser frequency can be utilized if approved by the Owner's Representative.

B. Laboratory Index Testing:

1. Compacted backfill for structures, structure foundations, sub grade for roadways and paved areas, embankments, and pipelines: Maximum dry density and optimum moisture content, Plasticity Index, and Gradation (when applicable) shall be confirmed at least once for every 2,500 cubic yards of fill placed.

2. In addition, at least one set of applicable index tests shall be performed for each distinct material type used as compacted fill at the site.

3. Additional tests may be performed, as directed by the Owner's Representative, whenever deviations in material properties or quality of workmanship are suspected.

C. Tests for compaction shall conform to references listed in Part 1.3 of this section.

D. Sample backfill materials per ASTM D75.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Where compacting of earth materials is required, the materials shall be deposited in horizontal layers and compacted as specified in this section. The excavation, placing, moistening, and compacting operations shall be such that the material will be uniformly compacted and will be homogeneous, free from lenses, pockets, streaks, voids, laminations, or other imperfections.

B. Relative Compaction:

1. All areas that fail to meet the minimum compaction requirements shall be reworked as required by the Owner's Representative and retested until minimum compaction requirements are obtained.

3.2 COMPACTION REQUIREMENTS

A. Unless otherwise specified or shown on the Drawings, a minimum of 90 percent of relative compaction.

3.3 COMPACTING CLAYEY AND SILTY (COHESIVE) MATERIALS

A. Where compaction of earth materials containing appreciable amounts of clay or silt is required, the materials shall be deposited in horizontal layers. The thickness of each horizontal layer prior to compaction shall not be more than eight inches. The excavating, placing, moistening and compacting operations shall be homogeneous, free from lenses, pockets, streaks, voids, laminations, or other imperfections such that the materials when compacted will be blended sufficiently to secure the highest practicable density.

B. Moisture Content:

1. Prior to and during compaction operations, the materials shall have an above optimum moisture content, but not greater than three percentage points of optimum moisture content, and the moisture content shall be uniform

throughout each layer. The optimum moisture content is defined as that moisture content which will result in the laboratory maximum dry density of the soil as determined using ASTM D1557 (or ASTM D698).

2. Insofar as practicable, as determined by the Owner's Testing Agency, moistening of the material shall be performed at the site of excavation; but if necessary, such moistening shall be supplemented by sprinkling at the site of compaction.

3. If the moisture content is less than optimum for compaction or is greater than optimum for compaction by more than three percentage points, the compaction operations shall not proceed, except with the specific approval of the Owner's Representative, until the material has been wetted or allowed to dry out, as may be required, to obtain a moisture content within the tolerances permitted above, and no adjustment in price will be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

C. When the material has been conditioned as herein before specified, it shall be compacted by rollers or by hand or power tampers. Where hand or power tampers are used to compact soils in confined areas such as under pipe, they shall be equipped with suitably shaped heads to obtain the required density.

3.4 COMPACTING COHESIONLESS FREE-DRAINING MATERIALS

A. Where compaction of cohesion less free-draining materials, such as sands and gravels, is required, the materials shall be deposited in horizontal layers. The thickness of each horizontal layer prior to compaction shall not be more than eight inches. The excavating, placing, moistening and compacting operations shall be homogeneous, free from lenses, pockets, streaks, voids, laminations, or other imperfections such that the materials when compacted will be blended sufficiently to secure the highest practicable density.

B. Moisture Content:

1. Prior to and during compaction operations, the materials shall have a moisture content at least equal to the optimum moisture content and shall be uniform throughout each layer. The optimum moisture content is defined as that moisture content which will result in the laboratory maximum dry density of the soil as determined using ASTM D1557 (or ASTM D698).

2. Insofar as practicable, as determined by the Owner's Representative, moistening of the material shall be performed at the site of excavation; but if necessary, such moistening shall be supplemented by sprinkling at the site of compaction.

3. If the moisture content is less than optimum for compaction, the compaction operations shall not proceed, except with the specific approval of the Owner's Representative, until the material has been wetted or allowed to dry out, as may be required, to obtain a moisture content above optimum, and no adjustment in price will be made on account of any operations of the

Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

3.5 ROLLERS

A. Rollers used for compacting earth materials shall have staggered and uniformly spaced tamping feet and be of sufficient weight for proper compaction.

B. The tamping heads and cleaner bars shall be properly maintained, and the spaces between the tamping feet shall be kept clear of materials which impair the effectiveness of the tamping rollers.

END SECTION

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SECTION 31 23 35

DISPOSAL OF MATERIALS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Disposal of unsuitable material, concrete, asphalt concrete, rubbish, and other debris, as described below.

1.2 RELATED WORK

A. Section 01 57 23 – Storm Water Pollution Prevention Plan

B. Section 01 57 27 – Dust Control

C. Section 03 33 10 –Concrete Site Work

D. Section 31 11 00 – Clearing and Grubbing

E. Section 31 23 31 – Compacting Earth Materials

1.3 REFERENCES

A. ASTM D75 – Practice for Sampling Aggregates.

B. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

C. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.

D. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

E. ASTM D2922 and D3017 – Density of soil and base rock in place by Nuclear method.

F. ASTM D2937 – Density of soil and in place by Tube method.

G. Section 26 – Aggregate Bases, State Standard Specifications.

H. Section 16 – Clearing and Grubbing, State Standard Specifications

I. Section 17 – Watering, State Standard Specifications

J. Section 19 – Earthwork, State Standard Specifications

K. *Geotechnical Engineering Investigation* entitled*, Geotechnical Engineering Investigation Report Proposed Well 38 Treatment* by BSK Associates, dated December 18, 2019.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 - Submittal Procedures.

1.5 GENERAL

A. The Contractor shall be responsible for the cleanup and disposal of waste materials and rubbish. The disposal of waste materials and rubbish shall be in accordance with applicable Federal, State, and local laws and regulations, and with the requirements of this paragraph. Should a conflict exist in the requirements for cleanup and disposal of waste materials, the most stringent requirement shall apply.

B. The Contractor shall keep records of the types and amounts of waste materials produced, and of the disposal of all waste materials on or off the jobsite.

C. The cost of disposing of waste materials other than unsuitable materials shall be included in the prices bid in the schedule for other items of work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 DISPOSAL OF EXCAVATED MATERIAL

A. All excess excavated material shall be hauled off site to a location selected by the Contractor, meeting the conditions of Paragraph 3.4 below.

B. All unsuitable material shall be hauled off-site and properly disposed.

3.2 DISPOSAL OF CONCRETE AND A. C. SURFACING

A. All concrete, A.C. and pavement removed from the project site shall be disposed of at a site obtained by the Contractor and approved by the Owner's Representative. No recyclable material shall be disposed of at any landfill. All disposable recyclable materials shall be disposed in a manner that facilitates recycling. The Contractor shall report quantities of disposed material in a manner that enables the Owner to utilize diverted quantities as diversion credits pursuant to California Integrated Waste Management Act of 1989 (Public Resources Code Sections 40000 et seq.)

3.3 DISPOSAL OF OTHER DEBRIS

A. All oil cake, wood debris, structure demolition, vegetation and any other debris removed from the project site shall be legally disposed of at a site(s) obtained by the Contractor with prior written permission of the Owner's Representative. Contractor shall identify the proposed Disposal Site(s) at the pre-construction conference. Such Disposal Site(s) shall be a properly licensed and permitted facility pursuant to state and local regulations for purposes of accepting delivery of the respective materials. No recyclable material shall be disposed of at any landfill. All disposable recyclable materials shall be disposed in a manner that facilitates

recycling. In addition to the following, a certificate of compliance stating disposal location and manner of disposal of recyclable materials shall be submitted to the Owner's Representative.

1. Disposal of combustible materials shall be by removal from the construction area. Disposal of combustible materials by burning will not be permitted. Disposal of waste materials by burying will not be permitted.

2. Waste materials shall be disposed of or recycled at a State approved disposal or recycle facility. The Contractor shall make any necessary arrangements with private parties, and State and county officials pertinent to locations and regulations of such disposal or recycle facilities, and shall pay any fees or charges required for such disposition.

3.4 CONTRACTOR'S DISPOSAL SITES

A. Contractor shall make arrangements for disposing of the materials at the Disposal Site(s) and pay all costs involved. Arrangements shall include, but not be limited to, obtaining written authorization from the property owner of the Disposal Site(s) and before disposing of any material off the project site, Contractor shall furnish to the Owner's Representative the authorization or a certified copy thereof together with a written release from the property owner absolving the Owner from any and all responsibility in connection with the disposal of material on the property of the Disposal Site(s). Before any material is disposed of on the Disposal Site(s), the Contractor shall obtain written permission from the Owner's Representative to dispose of the material at the location designated in the authorization.

B. It is expressly understood and agreed that the Owner assumes no responsibility to the Contractor whatsoever by the granting of such permission and Contractor shall assume all risks in connection with the use of the Disposal Site(s). The Contractor is cautioned to make such independent investigation and examination as the Contractor deems necessary to be satisfied as to the quantity and types of materials which may be disposed of on the Disposal Site(s) and the status of any permits or licenses in connection therewith.

C. Within 24 hours of removing the respective material from the project site for disposal, Contractor shall provide Owner's Representative with a certified copy of the weight slip from the Disposal Site obtained by Contractor upon delivery of such debris, and a certified statement from Contractor identifying the material constituting the debris and that it was disposed of at the Disposal Site (identifying the and name of the owner) in accordance with all laws and applicable regulations promulgated by Federal, State, regional, or local administrative and regulatory agencies.

3.5 DISPOSAL OF HAZARDOUS WASTE AND MATERIALS

A. Materials or wastes, defined as hazardous by 40 CFR 261.3, or by other Federal, State, or local laws or regulations, used by the Contractor or discovered in work or storage areas, shall be disposed of in accordance with these specifications and applicable Federal, State, and local laws and regulations. Unknown waste materials

that may be hazardous shall be tested, and the test results shall be submitted to the Owner's Representative for review.

B. Waste materials known or found to be hazardous shall be disposed of in approved treatment or disposal facilities. Hazardous wastes shall be recycled whenever possible. A copy of all hazardous waste manifest shall be sent to the Owner's Representative.

C. Waste materials discovered at the construction site shall immediately be reported to the Owner's Representative. If the waste may be hazardous, the Owner's Representative may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

D. If necessary, the Contractor will be required to conduct an environmental site assessment at the following Contractor use locations:

1. All hazardous waste accumulation areas;

2. All hazardous material and petroleum dispensing and storage areas where the aggregate storage of hazardous materials or petroleum at the site is or has been over 110 gallons.

3. This site assessment shall be performed by a qualified environmental consultant or equivalent and shall document through appropriate analytical sampling that the site is free of the effects of contamination (i.e., contaminant concentrations less than State action cleanup levels).

3.6 CLEANUP

A. The Contractor shall keep work and storage areas free from accumulations of waste materials and rubbish, and before completing the work, shall remove all plant facilities, buildings, including concrete footings and slabs, rubbish, unused materials, concrete forms, and other like materials, which are not a part of the permanent work.

B. Upon completion of the work, and following removal of construction facilities and required cleanup, work areas shall be regraded and left in a neat manner conforming to the natural appearance of the landscape.

END SECTION

SECTION 32 11 23

AGGREGATE BASE

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish, spread, and compact aggregate base in roadways, driveways and other paved areas as shown on the Plans.

B. The work of this section consists of furnishing and placing aggregate base material and/or lean concrete base materials, and filler if required, on the prepared subgrade.

1.2 RELATED WORK

A. Section 31 23 00 – Earthwork

B. Section 31 22 19 – Finish Grading

C. Section 31 23 31 – Compacting Earth Materials

D. Section 32 12 13 – Bituminous Prime and Tack Coat

E. Section 32 12 16 – Asphalt Concrete Paving

1.3 REFERENCES

A. Section 10-6 – Watering, State Standard Specifications.

B. Section 26 – Aggregate Bases, State Standard Specifications.

C. Section 28-2 - Lean Concrete Base, State Standard Specifications.

D. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

E. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.

F. ANSI/ASTM D1556 – Density of Soil and Base Rock in Place by Sand-Cone Method.

G. ASTM D6938 – Density of Soil and Base Rock in Place by Nuclear Method.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures.

B. If materials are obtained from a commercial source, submit certification from the supplier certifying that aggregate base course meets the requirements of this section.

C. Copies of certified weight tickets for each load of aggregate delivered to the project site.

1.5 QUALITY ASSURANCE

A. Relative Compaction:

1. All costs for initial compaction tests shall be borne by the Owner. All areas that fail to meet the minimum compaction requirements shall be reworked as required by the Engineer and retested until minimum compaction requirements are obtained.

2. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project. Testing will be required as directed by the Engineer. Test locations shall be determined by the Engineer upon notification from the Contractor that the grade is ready for tests. Contractor shall be present when samples of bedding, select backfill, and backfill materials are gathered for analysis or testing.

B. Compaction tests will be performed for each lift or layer.

C. Tests for compaction shall conform to references listed in Part 1.3 of this section

D. Sample backfill materials per ASTM D75.

E. Compaction testing will be performed in accordance with Section 19-5 of the State Standard Specifications.

1. Compaction testing of areas to be saw cut and replaced shall be one for every 300-LF of adjacent curb and gutter but not less than one for each curb cut area.

2. The Contractor shall not proceed with work over the area being tested until results have been verified by the Engineer. Immediately upon completion of each compaction test, a copy of the results shall be given by the testing laboratory to the Engineer.

3. Test every 10,000 square feet of engineered fill or aggregate base material placed. The Contractor shall not proceed with work over the area being tested until results have been verified by the Engineer. Immediately upon completion of each compaction test, a copy of the results shall be given by the testing laboratory to the Engineer.

F. The percentage composition by weight shall conform to Class 2 aggregate base determined by Test Method No. Calif. 202, modified by Test Method No. Calif. 905 if there is a difference in specific gravity of 0.2 or more between the coarse and fine portion of the aggregate or between blends of different aggregates.

G. Aggregate base shall also conform to the following quality requirements:

Tests	Test Method Calif. No
R-Value	301
Sand Equivalent	217
Durability Index	229

H. Quality Control shall be under the provisions of Section 01 43 00 – Quality Control.

PART 2 PRODUCTS

2.1 MATERIALS

A. AGGREGATE BASE

1. Class 2 Aggregate Base, ¾-inch maximum; as per Section 26-1.02B, State Standard Specifications.

2. Crushed Portland cement concrete which meets the gradation requirements of State Standard Specification Section 26, Class 2 Aggregate Base, ¾-inch maximum, may be used as aggregate base course under new pavements.

3. Aggregate for Class 2 aggregate base shall be free from organic material and other deleterious substances

B. LEAN CONCRETE BASE

1. Lean Concrete Base shall conform to the State Standard Specifications, Section 28-4, Lean Concrete Base Rapid Setting.

2. State Standard Specifications Section 28-4.04 shall not apply.

C. WATER

1. At the time aggregate base is spread, it shall have a moisture content sufficient to obtain the required compaction. Such moisture shall be uniformly distributed throughout the materials.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. As specified in Sections 31 23 00, Earthwork.

3.2 SPREADING

A. The aggregate base course material shall be deposited and spread to the required compacted thickness by means that will maintain the uniformity of the mixture. The aggregate base course shall be free from pockets of coarse or fine material.

B. Deliver aggregate base to the area to be paved as a uniform mixture and spread each layer in one operation.

C. Aggregate base placed at locations which are inaccessible to the spreading equipment shall be spread in two layers by any means to obtain the specified results.

D. The aggregate shall not be treated with lime, cement or other chemical materials before the Durability Index test has been performed.

E. The surface of the finished aggregate base at any point shall not vary more than ±0.05-foot from the grade shown.

3.3 PLACING

A. If the required compacted depth of the aggregate base course exceeds 6 inches, place course in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

3.4 MIXING

A. Mixing shall be in accordance with one of the methods set forth in State Standard Specifications, Section 28-4.03B.

3.5 MOISTURE CONTROL

A. When spread, aggregate base shall have a moisture content sufficient to obtain the specified compaction.

3.6 SURFACE FINISHING

A. Use a smooth steel wheel roller for the final rolling of top surface base course. Water surface and evenly spread loose stones before final rolling. Make minimum of two complete passes over area to embed stones. Correct soft spots developed during rolling.

B. Compacted aggregate base course surface shall be smooth and free from waves and other irregularities. Unsatisfactory portions of base course shall be corrected, at no additional expense to the Owner.

3.7 MATERIAL ACCEPTANCE REQUIREMENTS

A. Acceptance will be based on periodic samples and tests taken following mixing and before placing.

3.8 TOLERANCES

A. Surface: The finished surface of the base course will be tested with a 10-foot straightedge or other device. The variation between any two contacts with the surface shall not exceed ±0.05 feet.

B. Width: Plan dimension, ±0.10 feet.

C. Thickness: Plan dimension, ±0.05 feet.

D. Any areas not complying with these tolerances shall be reworked to obtain conformity, at no additional expense to the Owner.

3.9 MAINTENANCE

A. Maintain base course in a satisfactory condition until surfaced or until final acceptance.

END SECTION

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SECTION 32 12 13

BITUMINOUS PRIME COAT AND TACK COAT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Prime Coat work consists of applying an application of asphalt or asphalt cutback, as specified, to the complete and compacted aggregate base course prior to placement of hot mix asphalt concrete.

B. Tack Coat work consists of an application of asphalt cutback between asphalt layers. Applying a very light application of asphalt emulsion diluted with water as a tack between asphalt layers to create an adhesive surface for new asphalt concrete pavement to adhere to, and applied to all existing vertical surfaces were new pavement is to be surfaced.

1.2 RELATED WORK

A. Section 31 22 19 – Finish Grading

B. Section 32 11 23 – Aggregate Base

C. Section 32 12 16 – Asphalt Concrete Paving

1.3 REFERENCES

A. Section 94 – Asphalt Emulsions, State Standard Specifications

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittal Procedures

B. Two copies of manufacturer's certification for each load certifying the bituminous material is of the type, grade, and quality specified.

C. One sample of asphalt cutback, in accordance with AASHTO T40-78, shall be taken for each load delivered to the project sites. Samples shall be stored in clean, airtight sealed containers at a temperature of not less than 40ºF, until tested.

1.5 PROJECT CONDITIONS

A. Apply bituminous material only during daylight hours, when surface is dry, temperature is above 50ºF, and weather is not foggy or rainy.

PART 2 PRODUCTS

2.1 BITUMINOUS TACK COAT

A. Asphalt for tack coat shall be RS-1 or RS-2, for Anionic asphalt emulsion or CRS-2 for Cationic asphalt emulsion.

1. Engineer shall select which asphalt emulsion shall be used. Use tack coat between asphalt lifts only if applied surface has been in place over 24 hours, or has been in service.

PART 3 EXECUTION

3.1 GENERAL

A. Protect the surface of sidewalks, curbs, other structures, and trees adjacent to the area being treated from being spattered or marred. If surfaces become spattered, clean in accordance with manufacturer's recommendations.

B. Do not clean or discharge distributor outside the project limits of work.

3.2 DISTRIBUTOR

A. Bituminous distributor and equipment for heating bituminous material shall be designed, equipped, maintained, and operated so that bituminous material, at even heat, may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallon per square yard. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and a full circulation spray bar adjustable laterally and vertically.

B. When applying tack and prime coats, take care to the give the surface a very light, even application of asphalt.

3.3 PREPARATION OF SURFACE

A. Immediately before applying the tack or prime coat, remove loose material, dirt, clay or other objectionable material. Take particular care in cleaning the outer edges of the strip to be treated, to ensure that the prime or tack coat will adhere.

B. Do not apply Prime Coat or Tact coat so far in advance that it might lose its adhesiveness as a result of being covered with dust of other foreign material.

3.4 APPLICATION

A. Tack Coat: Apply tack coat uniformly at the rate of 0.10 gallon per square yard, at specified temperature. Apply within 24 hours preceding placement of the covering course.

B. Tack coat of asphaltic emulsion shall be furnished and applied in conformance with the provisions in Section 94, State Standards Specifications and shall be applied to all vertical surfaces of existing pavement, curbs gutters and construction joints in the surfacing against which additional material is to be placed, and to other surfaces designated in the special provisions.

END SECTION

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SECTION 32 12 16

ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of constructing one or more surface courses composed of a mixture of aggregate, filler if required, asphalt material and placed on a prepared base to lines, grades and details, as shown on the plans and covered within these specifications. This section includes asphalt patching for areas where utility lines cross existing paved surfaces, trench resurfacing, saw cutting and resurfacing additional paving widths as required in the contract or under permit requirements.

B. Mix aggregate and asphalt binder at a central mixing plant. Haul, spread, and compact the mixture for paved areas as shown and as specified.

C. Upon completion of all paving, finish the entire roadway. Trim and shape cut and fill slopes to produce smooth surfaces and uniform cross sections. Clean the finished pavement of all dirt and foreign material.

D. Cross sections of paving shall be as indicated in the Plans.

1.2 RELATED WORK

A. Section 31 23 00 – Earthwork

B. Section 32 11 23 – Aggregate Base

1.3 REFERENCES

A. Section 22 – Finishing Roadway, State Standard Specifications

B. Section 39 – Asphalt Concrete, State Standard Specifications

C. Section 92 – Asphalt Binders, State Standard Specifications

D. Section 94 – Asphaltic Emulsions, State Standard Specifications

E. Section 96 – Geosynthetics, State Standard Specifications

1.4 SUBMITTALS

A. As specified in Section 01 33 00 –Submittals.

B. Certificates:

1. Certification from the supplier that the asphalt concrete is of correct type and meets requirements of this section.

2. Job mix formula shall be submitted with certification that the mix formula meets the requirements of Standard Specification Specifications Section 39, Asphalt Concrete. The job mix formula shall include definite single values for:

   a. The percent of aggregate passing the specified sieve, based on dry weight of aggregate.

   b. The percent of bituminous material to be added, based on the total weight of the mix.

   c. Kind and amount of chemical additives (anti-stripping, hydrated lime, etc.) as established by the design procedure.

   d. Maximum theoretical density.

   e. Temperature ranges for the bituminous material at the point of mixing with the aggregates and bituminous mixture at the paving machine.

1.5 QUALITY ASSURANCE

A. Asphalt concrete supplier to prepare a mix design; to recommend adjustments to the proportions of the mix, as necessary, to conform to the mix design; and to consult with the Contractor and the Engineer during paving as required.

B. Testing required to, determine compliance for the work of this section shall be performed by an independent testing laboratory, approved by the Engineer and appointed and paid for by the Contractor. The independent testing laboratory shall be used to sample and test asphalt concrete at the job sites. One test shall be taken for each paving period and at least one test every four hours. As a minimum, results of the test shall include items A, B, C and E of the job mix formula submittal.

C. Density: Acceptable density of the in-place asphalt concrete pavement shall be 95 percent of the optimum values as determined from the mix design formula. Field sampling and density determination shall be made in accordance with AASHTO T230-68, or an accepted nuclear procedure.

D. Testing shall be performed in such a manner that will least encumber the performance of the work. The Contractor shall cooperate by rerouting equipment or by temporarily closing the immediate work area to be tested.

E. Contractor shall instruct the testing laboratory to provide the test results to the Engineer immediately in the field and a copy of the written report sent directly to the Engineer.

PART 2 PRODUCTS

2.1 ASPHALTS

A. Asphalt binder to be mixed with aggregate shall be liquid asphalt PG 64-16, conforming to State Standard Specifications Section 92, Asphalt Binders.

B. Asphalt Concrete shall be Type A, in accordance with State Standard Specifications 39-2.02.

2.2 AGGREGATE

A. The combined aggregate grading of the asphalt concrete shall be Type A, 3/4-inch maximum grading, per Section 39-2.02B(4)(b), of the State Standard Specifications.

2.3 PAVEMENT REINFORCING FABRIC

A. Reinforcing fabric shall be non-woven, conforming to Section 96-1.02J, “Paving Fabric”, of the State Standard Specifications.

B. Fabric shall be protected from damage during storage, handling and installation in accordance with manufacturer’s requirements.

2.4 FORMS

A. Redwood header boards shall be two inches wide by six inches deep (nominal measurement).

B. Metal forms shall be submitted to Engineer for approval prior to use.

PART 3 EXECUTION

3.1 GENERAL

A. The pavement section shall comply with City of Turlock Standards and as shown on the Plans.

B. Prior to any paving and surfacing operations, all pipes and conduits shall be installed and properly backfilled as shown.

3.2 STORAGE

A. Storage of materials shall comply with the requirements of Section 39, State Standard Specifications.

3.3 MIXING

A. Mixing shall conform to the approved mix design.

B. The weight of asphalt binder to be mixed with aggregate shall be between 3 percent and 7 percent of the weight of the dry aggregate.

3.4 SUBGRADE

A. Subgrade shall conform to Section 39-2.01C(3)(b), State Standard Specifications.

B. Unless otherwise specified, the upper six inches of subgrade beneath the structural section shall be scarified, moisture conditioned as necessary and compacted to at least 95 percent relative density.

3.5 EQUIPMENT

A. Spreading and compacting equipment shall conform to State Standard Specifications Section 39-2.01C(2), Spreading and Compacting Equipment.

3.6 PLACING AND COMPACTING

A. Placing and compacting shall conform to State Standard Specifications Section 39-2.05(3)(d), Placing and Compacting Hot Mix Asphalt.

B. Apply mixture only during hours of daylight; when air temperature is 50 degrees F or higher; when surfaces to be paved are dry and free of frost, snow or ice; and when precipitation is not imminent.

3.7 PAVEMENT REINFORCING FABRIC

A. Fabric shall be protected from damage during storage, handling and installation in accordance with manufacturer's requirements.

B. Pavement reinforcing fabric shall be placed, with paint binder, on all surfaces to receive an asphalt concrete overlay in accordance with State Standard Specifications Section 39-2.01C(3)(g), Geosynthetic Pavement Interlayer, and the following provisions:

1. Pavement surface shall be cleaned of loose material all cracks filled with emulsion slurry. The prepared surface shall be treated with paint binder at the rate of 0.25 gallons per square yard or as directed by the Engineer. Paint binder shall be un-cut asphalt or asphalt emulsion free of solvents and shall be applied at the proper temperature for the material.

2. Reinforcing fabric shall be carefully placed to avoid wrinkles. Any wrinkles longer than 1 inch shall be cut and laid flat in the direction of the paving operation. Material shall be lapped four to six inches for transverse joints and two to four inches for longitudinal joints. Extra tack coat shall be applied to joints to ensure proper bonding.

3.8 FORMS

A. Wood or metal. Place true to line and grade, and anchor securely. Use adequately sized forms or prevent bulging and bending while the bituminous surface is being worked.

3.9 COLD PLANE ASPHALT CONCRETE PAVEMENT

A. Existing asphalt concrete shall be cold planed at the locations and to the dimensions shown on the plans and in accordance with these special provisions.

B. The depth, width and shape of the cut shall be as indicated on the typical cross sections or as directed by the Engineer. The final cut shall result in a uniform surface conforming to the typical cross sections. The road surfacing to remain in place shall not be damaged in any way.

C. The depth shown on the plans for cold plane wedge cuts along existing concrete gutter are to be measured from the surface of the concrete gutter. In some cases where a prior overlay surface was constructed above the gutter lip, the actual depth of cut will exceed the dimension shown on the Plans.

D. The Contractor shall remove existing pavement overlay from the top surface of gutters adjacent to any area specified to be cold planed.

E. The planing machine shall be self-propelled and especially designed and built for grinding flexible pavements. It shall plane without tearing or gouging the underlying surface and blade material in a windrow. Drum lacing patterns shall permit a grooved or smooth surface finish as selected by the Engineer and the drum shall be totally enclosed in a shroud to prevent discharge of any loosened material into adjacent work areas. A zero (0) inches to three (3) inches deep cut to predetermined grade may be required on one (1) pass. The machine shall be adjustable as to crown and depth. The equipment shall meet the standards set by the San Joaquin Valley Air Pollution Control District and the Air Quality Act of 1969 for noise and air pollution.

F. The Contractor shall provide a smaller machine to trim areas inaccessible to the larger machine at manholes, curb returns and intersections. The smaller machine shall be equipped with a 12-inche wide cutting drum mounted on a three wheel chassis allowing it to be positioned without interrupting traffic or pedestrian flow. Jack hammering areas not accessible to grinding machine will not be allowed.

G. The surface tolerance produced shall be such that a ten-foot straight edge laid laterally will indicate variances of less than three-eighths (3/8) inch. The Contractor shall remove all loosened material from the roadway each day before leaving the site of the work.

H. The Contractor shall protect structures and provide necessary traffic control and barricades as required by the Engineer.

I. Temporary oil-sand ramps shall be constructed at intersecting streets, and along longitudinal joints, immediately after cold planing and prior to opening the lanes to

traffic. Cold planing operations shall not commence until temporary oil-sand is on site with workers to place material.

J. Cold planing cuts across travel lanes shall be the last cuts made at each side. After removal of loosened material from such cuts, temporary ramps shall be constructed of oil-sand at the deep end of cuts before opening the lane to traffic.

K. Irregular, gouged, ripped or damaged areas, as determined by the Engineer, shall not be accepted. All such areas shall be repaired by methods approved by the Engineer, prior to resurfacing operations. The Engineer, at his discretion, may require substitution of planing machine and/or operating personnel if the cold-planed surface does not meet these specifications.

L. Existing traffic detector loops damaged during cold plane operations will be returned to their original condition.

M. After conducting cold planing operations on a given street, the Contractor shall begin pavement operations on that street within seven calendar days. Deviations from this requirement must be requested in writing and approved by the Engineer prior to the beginning of planing operations.

3.10 MISCELLANEOUS AREAS

A. Paving miscellaneous areas shall conform to State Standard Specifications Section 39-2.01C(9), Miscellaneous Areas and Dikes.

3.11 FINISHING PAVED AREAS

A. Finishing roadway and parking areas shall conform to the provisions of State Standard Specifications Section 22, Finishing Roadways.

3.12 TRENCH RESUFACING

A. At areas where asphalt concrete had been removed due to pipeline construction, trench shall be resurfaced with asphalt concrete. Unless otherwise noted, asphalt concrete resurfacing shall match the existing thickness of the asphalt and base course removed.

1. Base course shall be as specified in Section 32 11 23, Aggregate Base, and in this Section.

B. If an edge of a trench resurfacing occurs within three feet of an existing edge of pavement, lip of gutter or the face of curb, or if no gutter is present, the Contractor shall remove all existing paving to the lip of gutter or curb face and or, edge of existing pavement and resurface with the applicable trench resurfacing section. The limits of removal are minimum requirements.

C. If during the Contractor’s operations pavement is disturbed outside the limits of removal, Contractor shall make the necessary repairs at no additional cost to the Owner.

3.13 ACCEPTANCE REQUIREMENTS

A. Surface Tolerance: The variation between any two contacts with the surface shall not exceed ±0.015 foot in 10 feet. Correct all humps or depressions exceeding the specified tolerance by removing defective work and replacing it with new material at no additional expense to the Owner.

B. A uniform compacted thickness shall be obtained for each course equal to or greater than the thickness shown. Individual tests shall not vary by more than ±0.02 foot.

C. Width: Plan dimension, ±0.02 foot.

D. Thickness: Plan dimension, ±0.02 foot.

END SECTION

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SECTION 32 12 36

SEAL COATS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish and apply a fog seal coat (asphalt emulsion without screenings) to asphalt concrete paving, including roadway, parking lots and driveway areas.

1.2 RELATED WORK

A. Section 32 12 16 – Asphalt Paving

1.3 REFERENCES

A. Section 37 – Bituminous Seals, State Standard Specifications.

B. Section 94 – Asphaltic Emulsions, State Standard Specifications.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittals.

B. The Contractor shall submit a certified copy of tests representing any shipment.

C. A Certificate of Compliance shall accompany each shipment of asphalt to the work.

D. The certificate shall include the shipment number, type of material, refinery, consignee, destination, quantity, contract or purchase order number, and date of shipment. The certificate shall state that the material complies with this section and shall be signed by the vendor or its representative.

1.5 PROJECT CONDITIONS

A. Apply bituminous material only during daylight hours, when surface is dry, air temperature is above 65º F, the surface temperature is 80 degrees or above, and weather is not foggy or rainy.

PART 2 PRODUCTS

2.1 MATERIALS

A. Asphaltic Emulsion shall conform to Section 94 of the State Standard Specifications

1. Asphaltic Emulsion shall be polymer modified, rapid setting and shall be anionic (PMRS2h) or cationic (PMCRS2h) in accordance with the type of aggregate to be used.

PART 3 EXECUTION

3.1 MAINTAINING TRAFFIC

A. At locations where public traffic is being routed over a surface upon which a seal coat is to be applied, the seal coat shall not be applied to more than one-half the width of the traveled way at a time, and the remaining width shall be kept free of obstructions and open for use by public traffic until the seal coat applied is ready for use by traffic.

B. Provide for the passage of public traffic through the work and when applicable or required, route traffic through the work under one-way control.

3.2 APPLICATION

A. Apply the fog seal coat in accordance with Section 37, “Bituminous Seals”, State Standard Specifications.

B. Seal coat shall consist of a fog seal applied to all asphalt concrete surfaces, including existing pavement, new pavement, overlays, and dikes in accordance with Section 37-2, “Seal Coats”, of the State Standard Specifications and the following provisions:

1. Seal coat shall be applied five days after the completion of all asphalt concrete pavement construction, overlays, and dike construction and after all surfaces have been cleaned of loose material.

2. Material shall be “Topein C” rejuvenator and sealant or approved equivalent and shall be applied at the rate of 0.10 gallons per square yard or as directed by the Engineer.

3.3 SURFACE PREPARATION

A. Immediately before application of seal coat, clean surface with a power or hand broom. Do not begin seal coating operation until the surface is approved by Engineer.

3.4 APPLICATION

A. Asphaltic Emulsion: Apply uniformly at the approximate rate of between 0.28 to 0.40 gallons per square yard at the specified temperature. The actual application rate will be determined in the field by the Engineer. If the texture of the surface is such that asphaltic emulsion penetrates too rapidly, a preliminary application of from 0.05 to 0.10 gallon per square yard of surface may be required.

1. Use approved devices to insure that the beginning and end of the asphaltic emulsion covered areas are positive and clean.

2. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Correct any skipped areas or deficiencies. Make junctions of spreads carefully to ensure a smooth riding surface.

3. Do not spread asphaltic emulsion in excess of the length that can be immediately covered with aggregate.

4. When operating under part-width construction, leave a strip of bituminous material, approximately six inches wide, uncovered to permit a slight overlap of the bituminous material.

END SECTION

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SECTION 32 84 00

IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Supply and install sprinkler irrigation system in the area as shown on the drawings.

B. Replace portions of the existing sprinkler irrigation system as shown on the drawings.

1.2 RELATED WORK

A. Section 31 23 17 – Trenching Backfilling and Compaction

B. Section 40 05 23 – Valves and Appurtenances

C. Section 40 05 00 – Pipe and Fittings

D. Division 26 – Electrical

1.3 SUBMITTALS

A. As specified in Section 01 33 00 – Submittals.

B. Shop drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings and heads to be used.

C. Product Data: Provide component specifications and control system logic and wiring diagrams.

D. An Operation and Instruction Manual shall be furnished. It shall include the complete technical description; complete operation, function, and performance; complete detailed servicing instructions and replacement parts list, and information regarding protection of the equipment. The manual shall also be equipped with record forms for collecting data during the initial break-in period and subsequent operation.

1.4 EXTRA MATERIALS

A. Provide:

1. Two sprinkler heads for each type and size.

2. Two valve keys for manual valves.

3. Two valve box keys.

4. Two keys for valve markers.

5. Two wrenches for each type head core and for removing and installing each type head.

PART 2 PRODUCTS

2.1 SPRINKLERS

1. Sprinklers shall conform to ASAE standard S398.1 and meet EPA guidelines for land treatment of treated wastewater.

2.2 PIPING

A. All irrigation piping shall be color coded purple as shown in Section 09 90 00 – Painting, to reflect the fact that treated effluent will be used.

PART 3 EXECUTION

3.1 EXCAVATION

A. Minimum depth of cover shall be at least twenty four (24) inches for pressure main piping; and a minimum depth of eighteen (18) inches for lateral discharge piping; or at a sufficient depth to accommodate valves and other equipment, whichever is greater.

3.2 PIPE FITTING AND ASSEMBLY

A. All pipelines shall be installed in the locations shown, shall be of the sizes indicated and the materials specified herein. Parallel piping shown on the drawings may be installed in the same trench. Piping shall be laid accurately to the line and grade required, with full bearing on the trench bottom. No pipe shall be laid on soft fill or other unstable materials. No direct contact between other pipes or structures will be permitted at crossings. The interior of the pipe shall be clear of foreign matter during installation and shall be kept clean by means of plugged or capped ends after lowering into the trench.

3.3 SPRINKLER AND QUICK COUPLING VALVES

A. Sprinkler and Quick Coupling Valves shall be set plumb and level with established turf at the locations indicated on the plans.

B. In turf areas where grass has not yet been established, sprinklers shall be initially installed on risers above grade level. When grass is established, the Contractor shall lower sprinkler heads to their permanent positions flush with the finished grade. This elevation is critical and care shall be taken to set them exactly at, or slightly above finished grade. Heads shall not be set below finish grade.

C. All Sprinklers and Quick Coupling Valves shall be installed on swing joint risers capable of remaining flexible to protect the piping and allow adjustment of the height to the turf grade. Sprinklers shall be spaced on indicated on the plans, and no spacing shall be greater than that recommended by the manufacturer for efficient water distribution.

3.4 VALVES

A. All valves shall be connected directly to the main line in a plumb position with sufficient clearance for service and operation. Remote Control Valves shall be as centrally located among the sprinklers as practical, in accordance with the plans. The valves shall be adjusted for proper operation as required by the manufacturer for specified performance.

3.5 CONTROL WIRE

A. Control wire shall be specifically designed for direct burial use. Sizes shall be in accordance with the minimums recommended by the controller manufacturer. A minimum loop of eighteen inches (18”) shall be left at each valve, at each splice, at each change in direction, and at each controller for expansion and/or servicing.

3.6 TESTING

A. All piping shall be hydrostatically tested at not less than 150% of designed operating pressure for not less than one hour, to the satisfaction of the Engineer and a record kept of the conditions, leaks, repairs and the date(s) of such tests.

B. All sprinklers, valves and controllers shall be tested for operation and performance with records kept of the results and date(s) of the tests. All necessary adjustments to the sprinkler equipment as required shall be made to assure efficient operation. The system shall be operated through at least one complete cycle before turning it over to the Owner for operation.

END SECTION

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SECTION 32 93 00

TREES, PLANTS, AND GROUNDCOVER

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide and install trees, plants and ground cover as shown on drawings and as specified herein.

1.2 RELATED WORK

A. Section 01 57 23 – Storm Water Pollution Prevention Plan

B. Section 31 22 19 – Finish Grading

C. Section 32 84 00 – Irrigation System

1.3 REFERENCES

A. ANSI Z60.1 – Nursery Stock

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittals.

B. Maintenance Data: Include watering frequency, and recommended coverage of fertilizer.

C. Submit list of plant life sources.

D. Soil Sample: Soil sampling shall be conducted in accordance with laboratory protocol, including protocols regarding adequate sampling depth for the intended plans.

1. The soil analysis shall include:

a. Soil texture

b. infiltration rate determined by laboratory test or soil texture infiltration rate table

c. pH

d. total soluble salts

e. sodium

f. percent organic matter and

g. recommendations

E. Wood Mulch: Submit a certificate of compliance for wood mulch.

1.5 SUBMIT A 2 CU FT MULCH SAMPLE WITH THE MULCH SOURCE SHOWN ON THE BAG. OBTAIN AUTHORIZATION BEFORE DELIVERING THE MULCH TO THE JOB SITE.QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with 3 years experience.

B. Installer Qualifications: Company specializing in installing and planting the plants with 3 years experience.

1.6 REGULATORY REQUIREMENTS

A. Comply with all regulatory requirements for fertilizer and herbicide composition and use.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products so as to prevent damage or injury.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Protect and maintain plant life until planted.

D. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may

drop below 35º F or rise above 90 º F.

1.9 WARRANTY

A. As specified in the General Conditions.

B. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.

C. Replacements: Plants of same size and species as specified, planted in the next growing season.

PART 2 PRODUCTS

2.1 TREES, PLANTS, AND GROUND COVER

A. Trees, Plants, and Ground Cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

2.2 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, free of impurities, plants, weeds and roots.

2.3 SOIL AMENDMENT MATERIALS

A. Fertilizer: Chemical make up and application rate shall be determined by the soil report

2.4 MULCH

1. Tree Bark Mulch

Tree bark mulch must be derived from cedar, Douglas fir, or redwood species. The mulch must be ground such that at least 95 percent of the material by volume is less than 2 inches long in any dimension and no more than 30 percent by volume is less than 1 inch long in any dimension.

2. Wood Chip Mulch

Wood chip mulch must:
1. Be derived from clean wood
2. Not contain leaves or small twigs
3. Contain at least 95 percent by volume of wood chips with a width and thickness from 1/16 to 3/8 inch and a length from 1/2 to 3 inches

3. Shredded Bark Mulch

Shredded bark mulch must:
1. Be derived from trees
2. Be a blend of loose, long, thin wood, or bark pieces
3. Contain at least 95 percent by volume of wood strands with a width and thickness from 1/8 to 1-1/2 inches and a length from 2 to 8 inches

4. Tree Trimming Mulch

Tree trimming mulch must:
1. Be derived from chipped trees and may contain leaves and small twigs
2. Contain at least 95 percent by volume of material less than 3 inches long for any dimension and not more than 30 percent by volume of material less than 1 inch long for any dimension

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared subsoil is ready to receive work.

B. Saturate soil with water to test drainage.

C. Verify that required underground utilities are available, in proper location, and ready for use.

3.2 PREPRATION OF SUBSOIL

A. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated soil.

B. Scarify subsoil to a depth of 6 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.3 FERTILIZING

A. Apply fertilizer at a rate as specified.

B. Apply after initial raking of topsoil.

C. Lightly water to aid the dissipation of fertilizer.

3.4 PLANTING

A. Place plants for best appearance (for review and final orientation by Architect/Engineer).

B. Set plants vertical.

C. Remove non-biodegradable root containers.

D. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from the root ball.

E. Place bare root plant materials so roots lie in a natural position. Maintain plant life in vertical position.

F. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.5 FIELD QUALITY CONTROL

A. Section 01 43 00 – Quality Control: Field inspection and testing.

B. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.6 MAINTENANCE

A Summary

This sections includes specifications for performing the 90 day plant establishment work.
Plant establishment consists of caring for the plants, including:

1. Controlling plant growth
2. Fertilizing
3. Controlling rodents, insects, and weeds
4. Replacing damaged plants
5. Watering
6. Operating irrigation system
7. Repairing new irrigation system

Working days on which no work is required are credited as plant establishment working days regardless of whether or not you perform plant establishment work.
If any component of the electric automatic irrigation system is operated manually, the day will not be credited as a plant establishment working day unless the manual operation is authorized.
Working days on which you fail to adequately perform plant establishment work are not credited as plant establishment working days.

Plant establishment period with the number of working days specified for plant establishment starting after all planting work has been completed, except for plant establishment work, and other bid items specified to be performed until Contract acceptance. The Department will not accept the Contract unless the plant establishment work has been satisfactorily performed for at least the number of working days specified for plant establishment.

Submittals

1. General

Submit seasonal watering schedules for use during the plant establishment period within 10 days after the start of the plant establishment period. Remote irrigation control system watering schedule must use the remote irrigation control system software program.
Submit updated watering schedules within 5 business days after any changes have been made to the authorized schedules.
Submit a revised watering schedule for each irrigation controller at least 30 days before completion of the plant establishment period.

2. Notification

The Engineer notifies you when the plant establishment period starts and furnishes statements regarding the number of working days credited to the plant establishment period after the notification.
Notify the Engineer at least 5 business days before applying each application of fertilizer.

B. Quality Assurance

Provide training by a qualified person on the use and adjustment of the installed irrigation controllers no more than 30 days before completion of the plant establishment period.
Perform a final inspection of the plant establishment work in the presence of the Engineer 20 to 30 days before Contract acceptance.

3.7 CONSTRUCTION

A. General

Keep plant basin walls well formed.
Clean new wye strainers and existing wye strainers that are a part of the new irrigation system annually until the completion of the plant establishment period. The last cleaning must be done within 15 days before the completion of the plant establishment period.
Remove, clean, and reinstall new filters and existing filters that are a part of the new irrigation system annually until the completion of the plant establishment period. The last cleaning must be done within 15 days before the completion of the plant establishment period.

B. Plant Growth Control

Prune plants planted as part of the Contract as authorized.

C. Fertilizing

Apply fertilizer to the plants as described and water into the soil after each application.
Apply fertilizer with a mechanical spreader, whenever possible.

D. Plant Staking

Replace plant stakes that are inadequate to support plants with larger stakes.
Remove plant stakes when the Engineer determines they are no longer needed.

E. Replacement Plants

Replacement of plants up to and including the 125th plant establishment working day must be with a plant of the same size as originally specified. Plants of a larger container size than those originally specified for replacement plants may be used during the first 125 working days of the plant establishment period.
Plants replaced after the 125th plant establishment working day must be the size shown in the following table:

Plant size (Original)	Plant size (Replacement)
Pot/liner/plug/seedling	No. 1 container
No. 1 container	No. 5 container
No. 5 container	No. 15 container

F. 20-4.03G Watering

Operate the electric automatic irrigation systems in the automatic mode unless otherwise authorized.
Water plants utilizing the remote irrigation control system software program unless authorized.
Implement the watering schedule at least 10 days before completion of the plant establishment period.

3.8 SCHEDULE – PLANT LIST

Refer to plans.

END SECTION

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SECTION 33 05 26

UTILITY LINE MARKING

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of furnishing and installing utility line marking tape in the trench above newly constructed utility lines.

1.2 SUBMITTALS

A. As specified in Section 01 33 0 0 – Submittal Procedures.

B. Samples: 24-inch strips of tape and two markers.

C. Certification that the materials used in the tape fabrication meet the requirements of this section.

D. Installation procedure if the cable is installed by plowing.

PART 2 PRODUCTS

2.1 MARKING TAPE

A. Capable of being inductively detected electronically.

B. Construction: Metallic foil laminated between two layers of impervious plastic film not less than 3 inches wide. Total thickness of tape shall not be less than 0.005 inch (5 mil), ±10 percent manufacturing tolerances.

1. Film: Inert plastic. Each film layer shall be not less than 0.001 inch (1.0 mil) thick.

2. Foil: Not less than 0.001 inch (1.0 mil) thick.

3. Adhesive: Compatible with foil and film.

C. Imprint: 3/4-inch or larger bold black letters.

D. Legend: Identify buried utility line tape with imprint such as "Caution: Sewer Line Below". Repeat identification at approximately 24 inch intervals.

E. Background Color: APWA color code and as specified in the following table.

Color	Utility
Safety Red	Electric

Color	Utility
High Visibility Safety Yellow	Gas, Oil, Steam, Dangerous Materials
Safety Alert Orange	Telephone, Communications, Cable Television
Safety Precaution Blue	Water System, Irrigation
Safety Green	Sanitary Sewer, Storm Sewer
Safety Brown	Force Mains and Effluent Lines
Purple	Reclaimed Water

F. Manufacturer: Lineguard, Inc., Wheaton, Illinois; Reef Industries, Inc., Houston, Texas; Thor Enterprises, Inc., Sun Prairie, Wisconsin; or Engineer-approved equivalent.

2.2 SURFACE MARKERS

A. All markers shall have an identifying letter either cast or routed into marker. The Contractor has the option of any of the following. However, only one type shall be used on any one project:

B. Cast-In-Place Concrete.

1. Concrete: As specified in Section 03 33 10 –Concrete Site Work.

2. Reinforcement: One No. 5 bar in center of the marker.

C. Precast Concrete: Commercially fabricated concrete marker meeting design dimensions and concrete reinforcing requirements.

D. Timber Posts: Any softwood lumber species meeting PS 20-70. Grade No. 1 or better, free of heart center, S4S as shown. Pressure treat timber posts for soil contact with waterborne preservative in accordance with AWPA C2-90.

2.3 TRACER WIRE

A. Minimum: No.10, solid, 12 AWG copper wire with Type TW insulation. Join so as to form a mechanically and electrically continuous line throughout the length of the marked pipe.

PART 3 EXECUTION

3.1 MARKING TAPE

A. Install tape in backfill directly over each buried utility line as shown on the detailed drawings.

B. Unless otherwise shown, tape shall be installed a minimum 1.5 feet below finish grade. However, in no case shall tape be placed closer than two feet above the top of the pipe.

C. Where utilities are buried in a common trench, identify each line by a separate warning tape. Bury tapes side by side directly over the applicable line.

3.2 TRACER WIRE

A. Wherever PVC or Polyethylene pipe is installed in the ground, a tracer wire shall be installed. Conductors shall be spliced in accordance with Division 26, Electrical.

1. Tracer wire shall be brought to the surface at all gate and butterfly valves, air valves, blow-offs, Fire Hydrants, Water Services, and other pipeline appurtenances

B. Tracer Wire: Attachment of the wire to the pipe shall be made with plastic tie-wraps or other approved method.

C. Contractor shall conduct a satisfactory continuity test prior to Owner acceptance.

3.3 SURFACE MARKERS

A. In addition to marking tape, install surface markers at all changes in horizontal direction and at intervals not exceeding 400 feet.

B. Tracer wire shall be wrapped around cast iron valve boxes; while ensuring wire conductors are making contact with valve box.

1. Tracer wires shall be tied together to a No. 5 rebar cast in a concrete utility line marker and terminate above grade. Allow sufficient slack in tracer wire along pipe to allow for pipe shrinkage and expansion.

END SECTION

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SECTION 33 13 00

DISINFECTION OF WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

A. Disinfection of all new potable piping, components, and appurtenances.

B. This shall include disinfection of all potable water piping, well, filters, and pumps.

C. New facilities shall be kept isolated from the active distribution system using a backflow, double check valve device per ANSI/AWWA C651 - Disinfecting Water Mains.

D. Before allowing water from the municipal supply system to enter the new potable water system, all its components shall be cleaned and disinfected.

E. Test and report results. Cost of all testing shall be borne by the Contractor.

F. Connect new system and existing water distribution mains, after all required test are satisfactory and approved by the Engineer.

1.2 RELATED WORK

A. Section 33 01 00 – Pipe and Fittings

B. Section 46 61 21 – Pressure Filters

1.3 REFERENCE

A. ANSI/AWWA C651 – Disinfecting Water Mains.

B. ANSI/AWWA C652 – Disinfection of Water Storage Facility

C. ANSI/AWWA C653 – Disinfection of Water Treatment Plants

D. ANSI/AWWA C654 – Disinfection of Wells

1.4 SUBMITTALS

A. Submit five copies of each compliance report to Engineer. Reports shall include the following information:

1. Disinfection report; accurately record:

a. Type and form of disinfectant used.

b. Date and time of disinfectant injection start and time of completion.

c. Test locations.

d. Initial and 24 hour disinfectant residuals in parts per million (ppm) for each location tested.

e. Date and time of flushing start and completion.

f. Disinfectant residual after flushing in ppm for each location tested.

g. Persons present during the disinfection operation.

2. Bacteriological report; accurately record:

a. Date issued, project name, and testing laboratory name, address, and telephone number.

b. Time and date of water sample collection.

c. Name of person collecting samples.

d. Test locations.

e. Initial and 24 hour disinfectant residuals in ppm for each location tested.

f. Coliform bacteria test results for each location tested.

g. Certification that water conforms, or fails to conform, to bacterial standards of the California State Water Resources Control Board.

h. Bacteriologist's signature.

B. Submittals shall be in accordance with 01 33 00, Submittals.

1.5 QUALITY ASSURANCE

A. Testing laboratory certified with the State of California for examination of drinking water.

1. Testing laboratory shall be selected by the Contractor and approved by the Owner.

2. All samples shall be gathered and tested by said Laboratory.

3. Contractor shall instruct the testing laboratory to provide the test results to the Engineer immediately upon results and a copy of the written report sent directly to the Engineer.

PART 2 PRODUCTS

2.1 CHLORINE

A. All disinfectant chemicals shall be certified to ANSI/NSF Standard 60

B. Chlorine-bearing compounds:

1. Calcium hypochlorite (comparable to commercial products known for example as HTH, Perchloron, and Pittchlor, sold for swimming pool chlorination).

2. Sodium hypochlorite (liquid bleach, sodium hypochlorite in powder or tablet form for pool chlorination).

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that system has been cleaned, inspected, and pressure tested.

B. If a chlorine-bearing compound is to be used, the calcium hypochlorite or sodium hypochlorite shall be prepared as a water mixture before introduction into the potable water piping system. The powder shall first be made into a paste and then thinned to approximately a 1- percent chlorine solution (10,000 ppm). The preparation of 1- percent chlorine stock solution requires the following proportions of powder to water:

Product	Amount of Compound	Quantity of Water (Gals)
High-test Calcium Hypochlorite (65 to 70 percent Cl)	1 lb.	7.50
Sodium Hypochlorite liquid (5.25 percent Cl)	1 gal.	4.25

3.2 APPLICATION

A. Provide and attach equipment required to execute work of this Section. This may include:

1. A solution-feed chlorination device.

2. A device to regulate rate of flow and provide effective diffusion of the gas into the water within the pipe being tested. Chlorinating devices for feeding solutions of the chlorine gas or the gas itself into the water shall provide means for preventing the backflow of water into the chlorine cylinder.

B. Preliminary Flushing: Before disinfection, the system with outlets open shall be flushed thoroughly with water. Flushing shall be done after the pressure test has been made. Flushing shall develop a velocity in pipes of at least 2.5 feet per second (fps).

C. Point of Application: The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension of any valved section, and through a corporation stop inserted by the Contractor (except in new distribution systems) in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension.

D. Retention Period: Treated water shall be retained for at least 24 hours.

E. Chlorinating Valves and Hydrants: In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

F. Circulate and flush repeatedly until specified cleanliness is achieved. Before being placed in service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than 25 mg/l free available chlorine remains in the water after 24 hours standing in the pipe.

3.3 TESTS

A. Samples shall be tested in accordance with ANSI/AWWA C651, C652, C653, and C654.

1. If disinfection fails to produce satisfactory test results, the new pipes and facilities may be re-flushed and retested. If samples taken after re-flushing also fail to produce satisfactory results, sections represented by those results shall again be disinfected and retested. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

END SECTION

SECTION 40 05 00

PIPE AND FITTINGS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish, install, and test all water, utility, pipe, fittings, and appurtenances as indicated and as specified.

1.2 RELATED WORK

A. Section 03 30 10 - Concrete Site Work

B. Section 09 90 00 - Painting and Coating

C. Section 31 23 00 – Earthwork

D. Section 31 23 17 – Trenching, Backfilling, and Compacting

E. Section 40 05 23 –Valves & Appurtenances

F. Section 40 20 10 - Pipe Supports

1.3 REFERENCES

A. California Plumbing Code

B. American Water Works Association Standards

1.4 SUBMITTAL REQUIREMENTS

A. Submit shop drawings in accordance with 01 33 00.

B. Submit manufacturer's catalog data. Show manufacturer's model number.

C. Submit dimensions including wall thickness and materials of construction by reference standard and grade. Submit information on interior and exterior coatings as applicable.

1.5 QUALITY ASSURANCE

A. All work performed under this section shall meet all recommendations and requirements of AWWA, California Plumbing Code, NFPA 24, ASTM D2774, and all other applicable national, state, local, standards and regulations.

1.6 MATERIALS

A. All materials in contact with potable water shall be certified to ANSI/NSF Standard 61.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

A. General: Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151) and shall be Class 52 unless shown otherwise. Pipe for grooved or flanged joints shall be no less than Class 53.

B. Joints:

1. Buried pipe and pipe fittings shall have push-on joints or mechanical joints conforming to AWWA C111. Flanged joints, sleeve-type mechanical couplings, and grooved-type couplings shall be used when shown.

2. For push-on joints, shape of pipe ends shall conform to ANSI A21.11 (AWWA C111). Gaskets and lubricant for pipe and fittings shall conform to ANSI A21.11 (AWWA C111).

3. For mechanical joints, dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints

4. For flanged joints, ends of pipe shall be provided with flanges conforming to ANSI A21.15 (AWWA C115), and to ANSI B16.5 for 150 lb. class. Bolts, nuts, and gaskets for flanged connections shall conform to ANSI B18.2.1. For grooved joints, groove specifications shall conform to ANSI/AWWA C606.

C. Fittings: Fittings with push-on, mechanical joint, grooved joints and flanged ends shall conform to ANSI A21.53 (AWWA C153). Fittings shall have pressure rating of 350 psi for 3”-24” and 250 psi rating for 30”-48” pipe. Fittings shall have cement-mortar lining equivalent to that of the pipe lining.

D. Coating and Lining: Pipe shall be bituminous seal-coated and cement-mortar lined. The lining shall conform to AWWA C104.

E. All buried ductile iron pipe shall be encased in an 8-mil lining of polyethylene, installed per AWWA C105.

2.2 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. Pipe shall be high molecular weight, high-density polyethylene pipe. The material shall conform to AWWA C906, PPI designation PE 3408 and have a cell classification of 345444C as described in ASTM D3350 and shall be, TYPE III, Grade PE34. The pipe shall contain no recycled compound except that generated in the manufacturer’s own plant from resin of same specification from the same raw material pipe. Polyethylene pressure pipe shall also conform to the applicable requirements of ASTM F714.

B. Pipe shall be rated for 250 PSI working pressure

C. The pipe inside diameter shall not be less than the nominal diameter specified or shown.

D. Unless shown otherwise on the Plans, the pipe dimension ratio shall be SDR 11 for pipes 10 inches and less.

E. All joints for the buried polyethylene pipe shall be of the thermal fusion type.

F. Polyethylene fittings shall conform to ASTM D3261. Each fitting shall be clearly labeled to identify its size and dimension ratio.

2.3 STEEL PIPE

A. General: Steel pipe 12-inches in diameter and smaller shall conform to the requirements of the "Specifications for Black and Hot-Dipped Zinc-Plated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses (ASTM A120), and shall be "Standard Weight" Steel Pipe larger than 12 inches in diameter shall be ASTM A139, AWWA C200, wall thickness not less than 0.18 inches.

B. Joints: Pipe 4-inches in diameter and larger shall be flanged or shall have grooved ends for Victaulic-type couplings. Where shown on the Plans, the pipe shall be flanged or plain end for flanged coupling adapters. Flanges shall be standard 150 psi flanges meeting the requirements of ANSI B16.1. Flanges shall be furnished with flat faces. Pipe smaller than 4 inches shall have screwed or grooved joints unless shown otherwise on the Plans.

C. Fittings: All fittings shall be flanged cast or ductile iron, screwed malleable iron, or Victaulic-type fittings. The Contractor may substitute Victaulic-type fittings for flanged fittings or screwed fittings unless the particular joint requires a specific end for compatibility with a valve or special fitting. All Victaulic-type fittings shall be of strength equal to the pipes with lining and coatings equivalent to that specified for the pipe.

D. Unless otherwise specified or noted in the Plans, all steel pipe 2-1/2 inch and smaller shall be Hot-Dipped galvanized, and pipes larger than 2-1/2 inch shall be black steel with epoxy or lining with minimum 10 mil dry thickness. Exterior surfaces of all pipe shall be shop primed. Finish coatings shall be as specified in Section 09 90 00 - Painting.

2.4 POLYVINYL CHLORIDE WATER PIPE (PVC)

A. General: PVC pipe 4 inches and larger in diameter shall conform to AWWA C900, unless otherwise specified.

B. The pipe shall be minimum PR 235 (DR 18) unless shown otherwise. Each length of pipe shall be marked with the manufacturer's name, nominal size, pressure classification, and date of manufacture.

C. Joints: Joints shall be push-on type couplings or integral socket bell PVC pipe unless otherwise shown with rubber gaskets conforming to ASTM D3139 and ASTM F477. Integral socket bells of PVC pipe or separate couplings shall meet the same

strength requirements as that of the pipe. All component parts of each joint including gaskets and coupling shall be clearly marked for use with the pipe for which they are intended.

D. Fittings: Fittings shall be of ductile iron conforming to ANSI A21.10 (AWWA C 153) for mechanical joints. Dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints

2.5 POLYVINYL CHLORIDE SCHEDULE PIPE

A. Refer to Section 40 20 90.

2.6 POLYVINYL CHLORIDE GRAVITY SEWER PIPE (PVC)

A. PVC gravity sewer pipe 4-inches through 15-inches in diameter shall conform to ASTM D3034, SDR 35. PVC gravity sewer pipe 18-inches through 36 inches in diameter shall conform to ASTM F679.

B. Each length of pipe shall be marked with the manufacturers name, nominal size and ASTM designation. Pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D1784 and shall have SDR of 35 and minimum pipe stiffness of 46 PSI according to ASTM Test D2412.

C. Joints: Pipe shall include an integral bell section with a factory assembled rubber ring gasket conforming to ASTM F477. Joint shall conform to ASTM D3212. Bells shall meet the same strength requirements as that of the pipe.

D. Fittings: Fittings shall be supplied by the pipe manufacturer and shall meet the strength requirement of the pipe. Integral bells and gaskets shall conform to the requirements for joints in this section. Fittings shall be marked with nominal size, manufacturers name and ASTM designation.

E. PVC sewer pipe 3 inches to 6 inches, for chemical drain shall conform to ASTM D2729 and D2949. Fittings shall be PVC with socket welded joints and shall conform to ASTM D2949 and ASTM D2665.

2.7 FLEXIBLE COUPLINGS FOR GRAVITY PIPES

A. Transition type couplings shall be factory manufactured to ensure watertight fit and smooth flow transition at the joint. Couplings shall be made of resilient elastomeric PVC, with all stainless-steel coupling bands including screw and housing. All materials shall be rustproof and unaffected by soil conditions or normal sewer gases, and shall be flexible with earth movement while maintaining seal. Poured concrete collar and similar coupling methods will not be accepted.

2.8 STAINLESS STEEL TUBING

A. Stainless steel tubing shall be made of Type 316 L stainless steel to the requirements of ASTM A269, of minimum 1/4-inch inside diameter, or as indicated, for the test pressure required. The fittings shall be swage ferrule design of Type 316

L stainless steel, of the double acting ferrule design, providing both a primary seal and a secondary bearing force. Flare bite or compression type fittings are not acceptable.

2.9 COPPER PIPE AND TUBING

A. Copper tubing shall conform to ASTM B88. Copper tubing for water piping shall have a weight of not less than Type K. Type L copper tubing shall be permitted to be used for water piping when piping is above ground in, or on, a building or underground outside of structures

B. Fittings:

1. Use soldered joints and fittings in exposed tubing service.

2. Use soldered joints and fittings in buried service.

3. Fittings and joints 3/8” and smaller in exposed service may be of the nut-and ferrule type with flared end connections or compression joint connections.

4. Use threaded joints and fittings in buried and exposed copper and brass piping.

C. Joints from copper tubing to threaded pipe shall be made using brass adapter fittings. The joint between the copper tubing and the fitting shall be a soldered brazed flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size screw joint.

D. Joints in copper tubing shall be made by the appropriate use of approved copper or copper alloy fittings. Surfaces to be joined by soldering shall be cleaned bright by manual or mechanical means. The joints shall be properly fluxed with an approved type flux and made up with approved solder. Solder and fluxes shall be manufactured to approved standards.

1. Solders and fluxes with a lead content that exceeds two-tenths (0.02) of one (1) percent shall be prohibited in piping systems used to convey potable water.

2. Solder shall be 95-5 (95% tin, 5% antimony) conforming to ASTM B32, Grade Sb5 or silver solder conforming to AMS 4773C.

3. Soldering flux shall comply with ASTM B813.

E. Only brazing alloys having a liquid temperature above 1000°F (538°C) shall be used.

F. Nut and Ferrule Fittings: Fittings shall be brass and or the Swagelok type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. End connections shall be of the union type.

G. Unions shall be the same size as the pipe or tube, three part, with copper flare end connections. Unions shall be bronze, ASTM B61 or B62. Unions shall be Mueller H-15400, Jones J-1528, or equal.

H. Provide an insulating union at the point of transition from copper tubing or piping to ferrous piping.

I. Buried tubing shall be polyethylene coated, tape wrapped, or encased in a PVC sleeve.

2.10 CHEMICAL PIPING AND TUBING

A. Unless otherwise noted on the drawings, chemical piping shall be Schedule 80 PVC or CPVC in accordance with Section 40 20 90. Piping called out as secondary containment piping shall conform to Section 40 24 68.

B. Where tubing inside of EPVC is called out on the drawings, chemical tubing and conduit shall be as follows:

1. EPVC shall consist of Schedule 80 PVC conduit or pipe utilizing long radius sweep elbows.

2. Chemical dosing tubing shall consist of FDA compliant PTFE tubing with a minimum working pressure of 90 psi at 150°F. HDPE, PVC, or PVDF tubing may be substituted provided that they meet the minimum working pressure requirement and are certified by the manufacturer to be suitable for the chemical service with an “excellent” chemical compatibility rating.

3. Sample tubing shall consist of odorless, tasteless, flexible black polyethylene tubing. Minimum operating pressure shall be 125 psi up to ½-inch in size and shall be ¼ of the burst pressure of the tubing. Tubing shall comply with ASTM D1248, Type I, Class A, Category 4, Grade E and shall be certified to ANSI/NSF Standard 61.

4. Fittings for tubing shall be compression type fittings rated at 150 psi minimum and constructed of a material compatible with the chemical service.

2.11 GROOVED COUPLINGS

A. Groove dimensions shall conform to AWWA C606.

B. Grooved couplings for ductile iron shall be Victaulic Style 31;

C. Flexible grooved couplings for steel pipe shall be Victaulic Style 77 or equal; rigid grooved couplings for steel pipe shall be Victaulic Style 07 or equal. Couplings shall be rigid unless otherwise noted on the drawings.

D. Grooved - Flanged adapters shall be Victaulic Style 341 for ductile iron pipe and Style 741 for steel pipe or equal.

E. Grooved coupling for high density polyethylene pipe shall be Victaulic Style 995 or 997 or equal.

2.12 FLANGED JOINTS

A. Flange shall conform to ANSI B16.5, Class 150.

B. All steel hardware installed underground shall be coated with a rust preventative, wrapped with 4 mil polyethylene sheeting, and secured with PVC tape.

C. Gaskets shall be meet the pressure requirements of the adjoining flanges and shall conform to AWWA C-207. Gaskets for flat faced flanges shall be 1/8-inch thick.

D. Gaskets for metallic pipe and non-potable 150 psi or less services shall be acrylic or aramid fiber bound with nitrile; Garlock Blue-Gard 3000 or equal. EPDM rubber gaskets, Garlock 98206 or equal, are also acceptable.

E. Gaskets for metallic pipe and potable water service shall be NSF/ANSI-61 certified EPDM rubber, Garlock 98206 or equal.

F. Gaskets for non-metallic flat faced flanges shall be constructed of a fluoroelastomeric material with a hardness of 70 durometer designed specifically for lower seating stress. Gaskets shall be certified to NSF/ANSI-61 for potable water service. Gaskets shall be Garlock Style XP or equal.

2.13 FLEXIBLE SLEEVE COUPLINGS

A. Flexible sleeve couplings shall be one of the following, or Engineer approved equivalent:

1. Dresser, Inc., Style 38 for Steel Pipe, and Style 253 Wide- Range for Steel, PVC, Copper, and Cast/Ductile Iron pipe.

2. Smith Blair, Inc., Series 411 or Wide-Range 461

3. Romac Industries, Inc., Style 400 for 12” and larger pipe or XR501 Extended Range Coupling, 4” thru 12” pipe size.

B. Center sleeves shall comply with the following

Nominal Pipe Diameter	Minimum Sleeve Length
6 inch and smaller	Manufacturer’s Standard
8 through 14 inch	7 inch
14 inch and larger	10 inch

2.14 FLEXIBLE SPOOL-TYPE EXPANSION COUPLINGS

A. Flexible rubber coupling shall be flexible joints, which includes a tube, body cover and flanges. The tube shall be a leak proof liner and the body shall consist of fabric and rubber compound, reinforced with steel wire or rings for strength. Flexible rubber coupling shall be either a single arch or double arch construction as indicated

in the Plans. Couplings shall have control rods to limit extension and flanges shall have backing rings. Couplings used for services with pressures greater than 75 psi shall have stainless steel flanges – rubber flanges with backing rings shall not be acceptable. Flexible couplings shall have minimum pressure ratings of 100 psi; couplings installed on suction of pumps shall have a minimum vacuum (pressure) rating of 30 inches Hg column.

B. Flexible coupling shall have Buna N liner and cover and shall be manufactured by Proco, Red Valve Company Inc., Metraflex Company or equal.

2.15 DOUBLE-SOCKET EXPANSION JOINT

A. Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.

B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 250 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.

C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 25º, 4” - 8”; 20º, 10” - 12”; 15º, 14+” and 8-inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.

D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.

E. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

F. Joints shall be The Force Balanced FLEX-TEND as manufactured by EBAA Iron, or equal.

2.16 MARKER TAPE FOR BURIED PIPING

A. Refer to 33 05 26, Utility Line Marking

2.17 TRACER WIRE

A. Install No. 10 solid-core copper tracer wire.

2.18 CONCRETE FOR THRUST BLOCKS

A. As specified in Section 03 30 00 – Cast-In-Place Concrete. Thrust blocks shall be used only where specifically permitted on the drawings or with pre-approval from the Engineer.

2.19 JOINT RESTRAINT COUPLINGS

A. Mechanical joint restraint coupling shall be of the type that utilizes the follower gland, and shall consist of several individual lug bolts with gripping mechanism that prevents the joints from pulling apart. Glands shall be ductile iron conforming to ASTM A536, and dimensions shall be compatible to be used with standard mechanical joint fittings for ductile rim pipe. The mechanical restraint joint shall have a minimum working pressure rating equal to that of the pipe with a safety factor of not less than 2. Restrained joints shall have twist off nuts to insure proper installation of restraining grip mechanism. Mechanical joint restrained coupling shall be EBAA, Iron, Inc. MEGALUG; with Mega-Bond coating.; or approved equal. Coating of gland follower body shall be electrostatically applied and heat cured polyester based powder. Wedge assemblies and bolts shall be coated with heat cured fluoropolymer coatings. Restraints shall be designed for the specific type of pipe to be restrained.

B. Restrained joint fittings shall meet Uni-B-13 for PVC and be FM and UL approved through 12-inch for both ductile iron and PVC.

C. Restrained joint fittings for high density polyethylene pipe shall be Victaulic 995 or 997 style coupling.

2.20 FASTENERS

A. All fasteners shall include washers under both bolt head and nut unless the use of washers is incompatible with the fitting design.

B. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located underground or submerged in liquid shall be Type 304 or 316 stainless steel per ASTM A320 or ASTM A193. Nuts shall be 304 or 316 stainless steel per ASTM A194 and washers shall be ASTM F436 Type 3.

C. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located indoors, above grade, and in vaults shall be carbon steel conforming to ASTM A307, Grade B with ASTM A563, Grade A nuts and ASTM F436 washers. Bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM F2329. Stainless steel meeting the requirements of Paragraph B shall also be acceptable.

2.21 INSULATING FLANGE SETS

A. Insulating flange sets shall be provided where indicated on the plans and shall consist of insulating gaskets, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall comply with ASTM A325. Insulating gaskets shall be full-face.

PART 3 EXECUTION

3.1 HANDLING AND DISTRIBUTION OF MATERIALS

A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Contractor shall replace damaged pipe at no additional expense to the Owner.

B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warping. Use protective covers where pipe may be damaged by direct sunlight.

C. No more than one week's supply of material shall be distributed in advance of pipe laying operations, unless otherwise approved or required.

D. Before laying, pipe shall be inspected for cracked, broken, or defective pieces. Such pieces shall be rejected. Pipe shall be carefully lowered into the trench to prevent damage. All dirt or other foreign matter shall be removed from inside the pipe before lowering into the trench.

3.2 COATING

A. Unless otherwise indicated in Part 2, all pipe and fittings shall be coated in accordance with specification 09 90 00.

3.3 INSTALLATION OF UNDERDRAINS

A. Perforated pipes shall be laid with the perforations down.

3.4 INSTALLATION OF BURIED PRESSURE PIPING

A. General: Pipe, fittings, and appurtenances shall be installed in accordance with the manufacturer's instructions and in accordance with the following references as appropriate:

1. Ductile Iron Pipe - AWWA C600

2. Polyvinyl Chloride Pipe and HDPE pipe - AWWA C605

3. Steel Pipe – AWWA C604

B. Handling: The pipe shall be protected to prevent entrance of foreign materials during laying operations. When laying is not in progress, open pipe ends shall be protected with a watertight plug or other approved means to exclude water or foreign material.

C. Alignment:

1. Mains shall be installed to the grades and elevations indicated and shall have a minimum cover of 30-inches from the top of the pipe to existing ground or paved surface unless otherwise indicated.

2. The allowable angle of deflection at any joint shall not exceed the amount recommended by the pipe manufacturer for the particular pipe size used. Deviation of any pipe section from the line and grade indicated shall not exceed 1/2-inch.

D. Joints:

1. Pipe shall be assembled and joined in accordance with the manufacturer's published instructions for the type of pipe and joint used. All portions of the joints shall be thoroughly cleaned before the sections of pipe are assembled. The ends of each pipe shall abut against the next pipe section in such a manner that there shall be no unevenness of any kind along the bottom half of the interior of the pipe. Where mechanical joints are used, the pipe shall be marked in such a manner that it can be determined after installation that the pipe is properly seated.

2. Where flexible couplings are used as expansion joints, the ends of the pipes shall be separated 1-inch to allow for expansion. The welded seam at the end of each coupled steel pipe shall be ground smooth for approximately 12-inches. Couplings shall be centered on pipe ends. Runs of pipe containing flexible couplings shall be properly blocked, anchored or tied to the structure to prevent joints from separating.

3. Mechanical restrained joints shall be installed in accordance with joint manufacturer’s instructions and recommendation.

E. Installation of Marker Tape: Install tape in backfill directly over each pipeline, 24 inches over top of pipe, unless shown otherwise on the Plans. Where utilities are buried in a common trench, identify each line by a separate marker tape. Place tapes directly over the applicable line.

3.5 THRUST BLOCKS OR MECHANICAL RESTRAINED JOINTS

A. Thrust blocks shall be used only where specifically allowed on the drawings or with prior approval by the Engineer.

B. Contractor shall submit shop drawings showing methods of joint restraint for each type of restrained joint fitting to be used including the length of pipe having restrained push-on joints on all pipes which connect to the restrained fitting.

C. When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used. Harness assemblies including tie bolts conform to ASTM A536.

3.6 INSTALLATION OF EXPOSED PIPING

A. General - Pipe shall be installed as specified, as indicated on the Plans or, in the absence of detail piping arrangement, in a manner acceptable to the Engineer.

B. Pipe shall be cut from measurements taken at the site and not from the Plans. All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction so as not to transmit noise resulting from expansion.

C. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, dirt, and other foreign matter when erected. The interior of all lines shall be thoroughly cleaned, to the satisfaction of the Engineer, before being placed in service.

D. Stuffing box leakage from water sealed pumps shall be contained and not allowed to into storm drains.

E. Taps for pressure gauge connections on piping and equipment shall be provided with a nipple and a ball type shutoff valve. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.

F. A union shall be provided within 2 feet of each end of threaded end valves unless there are other connections that facilitate easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or equipment that may require removal in the future and at locations required by the Plans or other sections of the Specifications.

G. Provide unions on exposed piping and tubing 3-inches and smaller as follows:

1. At every change in direction (horizontal and vertical.

2. Downstream of valves, 6 to 12 inches.

3. As shown on plans.

H. In all piping except air piping, insulating fittings shall be provided to prevent contact of dissimilar metals.

I. Pipe Joints - Pipe joints shall be carefully and neatly made in accordance with the requirements that follow.

1. Threaded - Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.

Threaded joints in plastic piping shall be made up with Teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with Teflon thread sealer and Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

Threaded joints in steel piping for chlorine service shall be made up with Teflon thread tape or paste applied to all male threads.

2. Compression - Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past finger tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque-free connection.

3. Flared - Ends of annealed copper tubing shall be cut square and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as required to produce leak tight connections.

4. Soldered and Brazed - Where solder fittings are specified for lines smaller than 2 inches, joints may be soldered or brazed at the option of the Contractor. Joints in 2 inch and larger copper tubing shall be brazed.

5. Flanged - Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly. Connecting flanges shall have similar facings, i.e., flat or raised face.

6. Welded - Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.

7. Grooved Couplings - Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions as set forth in AWWA C606 and shall be clean and sharp without burrs or check marks.

3.7 ACCEPTANCE TESTS AND INSPECTION FOR GRAVITY PIPING

A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.

2. If any of the tests or inspections covered in this section indicates that sewers require repair, then after repairs are complete, all testing and inspection shall be performed again. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

3. Prior to testing, all lines shall be thoroughly cleaned by flushing, and shall have passed a Wayne ball of appropriate size. Contractor is to submit to the

Engineer a detailed procedure on protecting the existing sewer system from contaminants during the flushing operation.

B. Mandrel

1. All sections of completed gravity pipe main lines shall be tested to assure that no potential obstructions are present in the lines. A rigid mandrel with a circular cross section having a diameter not less than 95% of the specified pipe diameter shall pass through the pipe without resistance.

C. Low-Pressure Air Test

1. Supply air to the test section slowly. A constant pressure of 3.5 psig shall be reached and maintain internal pressure of at least 3.0 psig for at least five (5) minutes.

2. After the stabilization period, disconnect the air supply. A pressure loss of 0.5 psig is used to compute the allowable pressure loss using the following formula.

3. The minimum allowable time in minutes for such a pressure drop is determined from the formula $T_{min} = 0.000183D^2L$, where:

   a. D = Nominal inside diameter of pipe (inches)

   b. L = Length of pipe test section (feet)

4. Regardless of the formula, the minimum time allowed for pressure drop shall be eight (8) minutes.

5. The pressure gage for monitoring the air pressure shall have a minimum division of 0.10 psi increments.

6. A valid test is when the air pressure is released from the opposite end of the inlet air entry connection with an air release apparatus outlet connection.

7. Adjustment of Pressure for Groundwater. Should the pipe section being tested lie below the local groundwater table, the test pressures shall be raised in proportion to the depth of the centerline of the pipe below the water table. Additional pressure (beyond the 3.5 psig specified above) shall be added at the rate of 0.433 psig per foot of depth below groundwater.

D. Video

1. Video inspection shall be performed on all new sewer mains. Video inspections shall be paid for by the Contractor and shall be completed prior to the final acceptance of the improvements.

2. The inspection video shall be in color and shall be recorded on DVD. The video shall become the property of the Owner.

3. The Engineer shall be the sole judge as to the acceptability of construction revealed by such inspection.

4. Within 24 hours prior to testing, all lines shall be thoroughly flushed with water to assist camera in the identification of low areas.

3.8 ACCEPTANCE TESTS FOR BURIED PRESSURE PIPING

A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.

B. In general, tests shall be conducted in accordance with AWWA C600 and C651 except as otherwise herein specified.

C. All newly installed sections of buried pressure piping shall be pressure and leakage tested as described herein.

1. For buried pressure pipelines, tests shall be made on two or more valved sections not to exceed 2,500 feet in length. The Contractor shall furnish all necessary equipment, material and labor required.

2. Tests shall be made after the trench has been backfilled and compacted, but not until at least 5 days have elapsed since any thrust blocks in the section have been poured.

3. The pipe shall be slowly filled with water and ensuring all air expelled from section being tested. The line shall stand full of water for at least twenty-four hours prior to testing to allow all air to escape. A test pressure equal to 1.5 times the design pressure, of the pipe measured at the point of lowest elevation pressure, or 100 psi, whichever is greater, shall be applied.

4. The test pressure in the line shall be maintained for a period of 2 hours. Test pressure shall be maintained within 5 psi during the test period. Conduct a leakage test concurrently with the pressure test. Leakage is defined as the volume of water that must be supplied into the newly laid pipeline to maintain pressure within +/- 5 psi of the test pressure after it is filled and purged of air. The water required to maintain test pressure shall be measured by means of a graduated barrel, drum, or similar device at the pump suction or through a meter.

Allowable leakage at the specified test pressure shall not exceed the amounts allowed by AWWA C600, $L = \frac{SD\sqrt{P}}{148{,}000}$

Where:

L = Testing allowance in gallon per hour.

S = Length of pipe tested in feet.

D = Nominal diameter of the pipe in inches.

P = Average test pressure during the hydrostatic test, in pounds per sq. inch.

Hydrostatic testing allowance per 1,000 ft. of pipeline in gph.

PSI	4”	6”	8”	10”	12”	14”	16”	18”	20”	24”
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62

5. Should testing disclose any visible leaks or leakage greater than that allowed, the defective joints or pipe shall be located, repaired, and re-tested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

3.9 ACCEPTANCE TEST FOR EXPOSED PIPING

A. Pipe to be Tested - All new installed piping sections shall be pressure and leakage tested as specified herein.

B. Pressure Testing - After the section of line to be tested has been filled with water or other test media, the test pressure shall be applied and maintained without interruption for 2 hours plus any additional time required for the Engineer to examine all piping undergoing the test and for the Contractor to locate all defective joints and materials.

1. Test medium shall be potable water for potable water piping; all other piping may be tested using plant water subject to Engineer’s approval.

2. Pipe system shall be tested at 1-1/2 times the operating pressure, or 100 psi, whichever is greater, using the appropriate test fluid medium.

3. All piping shall be tight and free from leaks. All pipe, fittings, valves, pipe joints, and other materials that are found to be defective shall be removed and repaired or replaced with new and acceptable material, and the affected portion of the piping be retested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

Compressed air or gas under pressure shall not be used to test plastic piping unless specifically recommended by the pipe manufacturer.

Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to the Engineer. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

END SECTION

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SECTION 40 05 14

FABRICATED STEEL SPECIALS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Fabricating, furnishing, and installing fabricated steel pipe, specials and connections to new and existing piping. Specials are defined as fittings, closure pieces, correction pieces, bends, reducers, nozzles, wyes, tees, crosses, outlets, manifolds and other steel plate specials.

1.2 RELATED WORK

A. Section 09 90 00 - Painting and Coating

B. Section 31 23 00 – Earthwork

C. Section 31 23 17 – Trenching, Backfilling, and Compacting

D. Section 33 05 00 – Pipe and Fittings

E. Section 40 05 23 –Valves and Appurtenances

F. Section 40 20 10 - Pipe Supports

1.3 REFERENCES

A. California Plumbing Code.

B. American Water Works Association Standards,

1.4 SUBMITTAL REQUIREMENTS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit dimensions including wall thickness and materials of construction by reference standard and grade.

C. Submit information on interior and exterior coatings as applicable.

D. Submit detailed layout and fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings, and pipe supports.

E. Joint and pipe fitting wall construction details which indicate the type and thickness of cylinder, the position, type, size and area of reinforcement, manufacturing tolerances, and all other pertinent information required for the manufacture of the product. Joint details shall be submitted where butt strap joints are required.

1.5 QUALITY ASSURANCE

A. Where fusion bond epoxy is specified, the fusion bond epoxy manufacturer shall have a record of at least one application of the proposed coating/lining material on a successfully performing fabricated steel pipe installation of comparable size and complexity constructed within the past two years.

B. All materials in contact with potable water shall be certified to ANSI/NSF Standard 61.

C. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds and plates for lug connections.

D. Welder Qualifications: All welding shall be done by skilled welders, welding operators and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used on the project shall be used in qualification tests.

PART 2 PRODUCTS

2.1 GENERAL

A. The pipe and specials shall be of the diameter and class shown on the drawings.

B. The Contractor shall insure all pipes and specials are legibly marked in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline.

2.2 PIPE MATERIALS

A. Steel pipe shall comply with ASTM A53 (Type E or S), ASTM A106 or AWWA C200; schedule 40 for pipe 10 inches diameter and smaller, and schedule 80 for pipe larger than 10 inches diameter, except as otherwise indicated.

B. Steel pipe shall be fabricated to meet requirements of AWWA C200. Fabricated pipe shall comply with ASTM A36, ASTM A572 (Grade 42), ASTM A570, (Grades 33 and 36), or ASTM A283 (Grade D), except that ASTM A53 and ASTM A106 pipe shall be grade B, straight or spiral seam. Pipe shall have minimum wall thickness of 7 gauge for pipe 24 inches in diameter and smaller, and a minimum wall thickness of 1/4-inch for pipe larger than 24 inches diameter.

2.3 FITTINGS

A. Threaded steel fittings shall conform to ASTM A47, ASTM A197 or ANSI B16.3.

B. Forged steel fittings shall conform to ASTM A234, ASTM A105 or ANSI B16.11.

C. Fabricated steel fittings shall conform to AWWA C208.

D. Full-flow cast fittings, or segmentally welded fittings with grooves or shoulders shall be designed and fabricated for standard grooved-end piping.

E. Ductile iron cast fittings shall conform to ASTM A536 or malleable iron conforming to ASTM A47.

2.4 PIPE DESIGN

A. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M-11, except that the design pressure, P, used in the AWWA Manual M-11 procedure shall equal the greater of 1.25 Pw or 0.9375 Pt. Unless otherwise shown outlets 2 inches in diameter and smaller, Weld-O-Let as specified in Section 15105, "Miscellaneous Piping, Valves, Fittings and Appurtenance," need not be reinforced.

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

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

2.5 PIPE LINING

A. Where indicated, pipe linings shall comply with the following:

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

C. Glass Lining: Pipe and fittings shall be glass lined with a vitreous material to a minimum thickness of 10 mils. Pipe and fittings shall have all internal welds ground smooth and voids and slag holes ground out, rewelded and ground smooth. Glass

lining shall provide continuous coverage when tested by a low voltage holiday detector.

D. Fusion Bonded Epoxy Lining: Where indicated, fusion bonded epoxy lining shall conform to the requirements of Paragraph 2.7.

2.6 PIPE COATING

A. Where indicated, pipe coatings shall comply with the following:

B. Coal-Tar Enamel Coating: Coal-tar protective coating shall be a multi-layer coal-tar enamel fibrous glass mat and mineral glass felt wrap conforming to ANSI/AWWA C203 except as indicated below:

1. Coating Conditions

a. Pipe surfaces shall be prepared by solvent cleaning (SSPC-SP1) followed by blasting to at least Commercial Blast Cleaning (SSPC-SP6) conditions.

b. Pipe temperatures shall be at least 85 degrees F.

2. Primer shall be type B.

3. Coal-Tar Enamel: Specially processed coat-tar pitch combined with inert filler, having no asphalt or petroleum of natural origin, of Type 1, applied hot.

4. Glass Fiber Wrap: Non-woven, either reinforced or non-reinforced, glass fiber mat uniformly impregnated with material compatible with coat-tar enamel.

5. Coal-Tar Enamel: Second coat matching the first.

6. Glass fiber or mineral felt outer wrap.

7. Whitewashing, latex painting, or kraft paper.

8. Coating Thickness: Primer plus coal-tar enamel shall be 3/32 inch thick, plus or minus 1/32 inch.

9. Continuity Testing: The entire coated surface of the pipe shall be electrically tested for continuity. Inspection voltage shall be calculated as:

$V = 1250[T]^{1/2}$

Where: V = Test voltage, volts
T = Total coating system thickness, mils

2.7 FUSION-BONDED EPOXY COATING AND LINING

A. Except as described below, the material system for the exterior and interior of fabricated steel pipe and specials shall be in accordance with ANSI/AWWA C213.

B. Minimum Pipe Diameter: The minimum pipe diameter for application of an internal lining shall be 8 inches for welded joint pipe, and 4 inches for gasketed joint pipe.

C. Maximum Temperature: This material system shall be able to withstand a maximum service temperature of 190°F.

D. Thickness: The powder shall be applied to the preheated pipe at a uniform cured thickness. The minimum nominal uniform cured thickness of the applied material shall be as follows:

1. Interior: 16 mils

2. Exterior: 14 mils

3. Maximum thickness shall be determined by the applicator based on the roughness of the pipe so as to obtain a holiday free product. Lining and coating thickness for pipe joints shall be compatible with dimensional tolerances.

E. Field-Welded Joints: The repair of field-welds shall be per Section 3.5 of ANSI/AWWA C213, EXCEPT that Subsection 3.5.3 shall not be used for the internal repair. After joint repair the joint shall be tested for continuity per subsection below.

F. Blast Cleaning: The pipe surfaces to be covered in the plant shall be blast-cleaned with steel grit to achieve a near white surface conforming to SSPC-SP10 or NACE TM-01-70 grade NACE No. 1.

G. Continuity Tests

1. Interior of pipe shall be electrically inspected for continuity at 2100 volts prior to exterior coating. At the option of the CONSTRUCTION MANAGER, if the number of holidays exceeds one per 3 linear feet of pipe 20 inches O.D. or smaller, or one per 2 linear feet of pipe over 20 inches O.D., the pipe shall be reprocessed. If not reprocessed, all defects disclosed by the holiday detector shall be repaired in the shop according to Subsection 3.4 - Coating Repair of the ANSI/AWWA C213 specifications.

2. Exterior of pipe shall be electrically inspected for continuity at 1965 volts prior to storage. At the option of the CONSTRUCTION MANAGER, if the number of holidays exceeds one per 3 linear feet of pipe length for pipe smaller than 14 inches O.D., or one per 25 square feet of surface area for pipe 14 inches in O.D. and larger, the pipe shall be reprocessed. If not reprocessed, all defects disclosed by the holiday detector shall be repaired in the shop according to Subsection 3.4 - Coating Repair of the ANSI/AWWA C213 specifications.

H. Coating Repair and Field Touch-Up: If gasketed joint pipe is used, exothermic weld connections for the installation of bond cables across joints of the pipeline for cathodic protection shall be repaired and touched-up with 3M-312 material or equal.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe shall be installed in accordance with AWWA M11, Chapter 16. Sleeve-type pipe couplings shall be installed in accordance with AWWA M11. Unless otherwise indicated, pipe lining and coatings shall comply with Section 09 90 00.

3.2 TESTING

A. Test specials using the hydrostatic, magnetic particle, ultrasonic, or radiographic methods as described in AWWA C200. Visual inspection only is not acceptable.

B. All exterior surface coatings on specials installed below grade shall be inspected electrically immediately before the pipe is lowered into the trench, following the same requirements for factory inspection procedure and voltage indicated above for the protective material. All holidays shall be repaired before the pipe is placed.

END SECTION

SECTION 40 05 23

VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, testing, and installation of manually operated valves and check valves including gate, butterfly, ball, hose bibbs, globe, check, solenoid, and vacuum breakers.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 60 – Air-Release and Vacuum-Relief Valves

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 - Submittals.

B. 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.

C. 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.

D. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

E. 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.”

F. For butterfly 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 PRODUCTS

2.1 GENERAL

A. Valves are identified in the drawings by size, category and type number. For example, a callout in the drawings of 6" Type-1 butterfly valve refers to Type-1 valve in the butterfly valve category in these specifications, which is a Class 125 rubber seated butterfly valve.

B. All valves installed in potable water applications shall conform to California AB 1953 no-lead regulations and ANSI/NSF Standard 61.

C. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

D. 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.

2.2 VALVE ACTUATORS

A. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

C. Provide 2-inch AWWA operating nuts for buried and submerged valves.

D. Provide enclosed gear actuators on butterfly 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.

E. Provide gear actuators on gate valves 14 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators shall be of the bevel or spur gear type. Provide grease case. Gearing shall comply with AWWA C500.

F. 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.

G. 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.

H. For buried or submerged service or valves installed in buried vaults, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

I. 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 stop.

J. 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.

K. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

L. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.3 CAST IRON VALVE BOXES AND RISERS

A. Valve boxes shall be Christy G5 with Christy Iron Covers or equal unless otherwise shown on the Drawings.

B. Risers shall be 8-inch nominal diameter PVC pipe conforming to AWWA C900.

2.4 INDICATOR POSTS

A. Indicator posts for buried gate valves in fire protection service shall be UL listed, FM approved for use on valves of sizes 4 through 12 inches. Provide a target or sign visible through a window on both sides of the post that indicates the open or shut position of the gate valve. Working parts shall be fully enclosed for weather protection. Body shall be cast or ductile iron. Provide post extension if trench is deeper than can be served by manufacturer's standard post. Coat buried portion of indicator posts per Section 09 90 00, System No. 21. Products: Nibco NIP-1, Stockham Figure G-951, or equal.

2.5 EXTENSION STEMS FOR BURIED AND SUBMERGED VALVE ACTUATORS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is

submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

B. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1 1/8
10, 12	1 1/4
14	1 3/8
16, 18	1 1/2
20, 24, 30, 36	1 3/4
42, 48, 54	2

2.6 FLOOR STANDS, EXTENSION STEMS, AND EXTENSION STEM SUPPORT BRACKETS

A. When required by the installations, provide floor stands and extension stems for operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.

B. Provide Type 316 stainless steel anchor bolts.

C. Provide steel extension stems for valves in exposed service. Provide Type 316 stainless steel stems for valves in submerged service.

D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be ductile iron. Coat ductile iron components with fusion-bonded epoxy per Section 09 90 00. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

2.7 CHAINWHEELS AND GUIDES

A. 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. Chains shall extend to within 4 feet of the operating floor. Chains shall be galvanized steel.

2.8 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be as described in Section 40 05 00.

2.9 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as described in Section 40 05 00.

2.10 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09 90 00. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field.

B. Coat buried metal valves at the place of manufacture per Section 09 90 00, System No. 7**.**

C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 09 90 00, System No. 1.

D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09 90 00, System No. 1. Apply lining at the place of manufacture.

E. Alternatively, line and coat valves with fusion-bonded epoxy.

F. Coat floor stands per Section 09 90 00.

G. 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.

H. Measure the thickness of the valve interior linings per Section 09 90 00. Repair areas having insufficient film thickness per Section 09 90 00

2.11 PACKING, O-RINGS AND GASKETS

A. 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).

2.12 RUBBER SEATS

A. 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.

2.13 VALVES

A. Gate Valves:

1. Type 1 – Aboveground Bronze Gate Valves 3 Inches and Smaller:

Aboveground gate valves, 1/4 through 3 inches, for water and air service shall be rising stem, solid wedge disc type. Materials of construction shall be as follows:

Component	Material	Specification
Body and bonnet	Bronze	ASTM B61 or B62
Disc or wedge	Bronze	ASTM B61, B62, or B584 (Alloy C97600)
Stem	Bronze or copper silicon	ASTM B99 (Alloy 651), B584 (Alloy C87600), B371 (Alloy C69400)
Seat rings (Classes 200 and 300 only)	Stainless steel	AISI Type 410

Handwheels shall be aluminum, brass, or malleable iron. Packing shall be Teflon or Kevlar aramid fiber.

2. Type 2 – Aboveground Bronze Gate Valves 3 Inches and Smaller (Low Lead)

Aboveground 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 113-LF or equal.

3. Type 3 - 2- and 3-Inch Cast-Iron Buried Gate Valves:

Buried gate valves of sizes 2 through 3 inches for water service shall be iron body, bronze mounted, nonrising stem type, double disc, parallel seat, and shall have a working pressure of at least 200 psi. Valves shall have flanged, PVC, or threaded ends to match the pipe ends. Valves shall have a 2-inch AWWA operating nut. Materials of construction shall be as follows:

Component	Material	Specification
Body, bonnet, operating nut, and stuffing box	Cast iron	ASTM A126, Class B or C
Bonnet bolts and stuffing box bolts	Stainless steel	ASTM A193, Grade B8M
Discs, disc nut, disc ring, and seat ring	Bronze	ASTM B62
O-ring	Synthetic rubber	
Stem	Copper silicon or manganese bronze	ASTM B584, Alloy C87600

Valves shall be Kennedy Figure 597X or 561X, Mueller Gate Valves, Clow F-5070 or F-5085, or equal

4. Type 4—Ductile-Iron Resilient Wedge Tapping Gate Valves 4 Through 16 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. 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. Ends shall be flanged, Class 125, ASME B16.1. One end shall have slotted bolt holes per AWWA C515, paragraph 4.4.1.3.4 to fit tapping machines.

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, Mueller, Waterous, Kennedy, or equal.

5. Type 5—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.

B. Butterfly Valves:

1. 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.

2. 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	8% maximum 0.25% (potable use)
Copper + Nickel + Silicon	83% minimum

3. 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.

4. Corrosion-Resistant Materials in Butterfly Valves:

Where AWWA C504 requires “corrosion resistant” material, such material shall be one of the following:

a. Bronze as described above.

b. Type 304 or 316 stainless steel.

c. Monel (UNS N04400).

d. Synthetic nonmetallic material.

5. 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.

6. Factory Leakage Testing:

   Perform factory leakage tests per AWWA C504 on both sides of the seat.

7. Type 1—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	Cast iron or 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, or 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 Valves shall be Pratt, DeZurik Series BAW, M&H, Val-Matic, or equal.

8. Type 2—Not Used.

9. Type 3—Flanged, Rubber-Seated Butterfly Valves 4 Through 48 Inches, Class 250:

   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 250. Minimum working pressure across the valve disc shall be 250 psi. Flanged ends shall be Class 250, ASME B16.1, with bolt hole drilling and bolt circle to match AWWA C207. Mechanical joint ends shall comply with AWWA C111. Provide the specified end connections on each end of the valve. Minimum working differential pressure across the valve disc shall be 250 psi in either direction. Valve shafts

shall be stub shaft or one-piece units extending completely through the valve disc. 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. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron or Ductile iron	AWWA C504
Exposed body cap screws and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Shaft	Stainless steel	ASTM A564, Grade S17400
Disc	Cast iron or ductile iron	AWWA C504
Disc fasteners, seat retainer segments, and seat fasteners	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N	—

Valves shall be Pratt, DeZurik, M&H, Val-Matic, or equal.

10. Type 4—Wafer Style, Rubber-Seated Butterfly Valves 2 Through 3 Inches, Class 200:

Valves of sizes 2, 2 1/2, and 3 inches 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 weldneck 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
	Ductile iron	ASTM A395, Grade 60-40-18
Shaft	Alloy steel	ASTM A564, Alloy S17400
	Stainless steel	ASTM A276, Type 316
Seat	Buna-N	—
O-rings	Buna-N	—

Pressure rating shall be at least 200 psi at a temperature of -30°F to +250°F. Valves shall be Norris R-200 or equal.

C. Ball Valves:

1. Type 1—Full Port Threaded Bronze Ball Valves 2 Inches and Smaller (Non-Potable Service):

Ball valves, 2 inches and smaller, for air or 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. Provide bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug ball retainer. Ball and stem shall be Type 316 stainless steel. Valves shall have threaded ends (ASME B1.20.1), nonblowout stems, reinforced Teflon seats, and have plastic-coated lever actuators. Valves shall be Stockham T-285 Series, Apollo 77C-140 Series, or equal.

2. Type 2—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.

Valves shall be Apollo 77CLF Series or equal.

3. Type 3—Bronze Ball Valve Curb Stops, 2 Inches and Smaller, for Water Service:

Ball valve curb 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 bronze (ASTM B584, Alloys C89833 or C89836). Components not in contact with water shall be bronze (ASTM B62 or ASTM B584, Alloys C83600, 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 Ball Valve Curb Stop B81-777 with straight lever handle or equal.

4. Type 4—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 bronze (ASTM B584, Alloys C89833 or C89836). Components not in contact with water shall be bronze (ASTM B62 or ASTM B584, Alloys C83600, 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.

5. Type 5—Bronze Angle Meter Stops for Water Service:

   Angle meter stops shall be bronze. Components in contact with water shall be bronze (ASTM B584, Alloys C89833 or C89836). Components not in contact with water shall be bronze (ASTM B62 or ASTM B584, Alloys C83600, 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 150 psi.

   For 1-inch service and smaller, use Ford Ball Meter Valve No. BA13-444W, James Jones J-1966W, or equal. Provide valve with inlet iron pipe threads and meter saddle nut outlet.

   For larger than 1- through 2-inch service, use Ford Ball Meter Valve No. BFA13-666W or BFA13-777W or equal. Provide valve with inlet iron pipe threads and meter flange outlet.

6. Type 6—True Union CPVC Ball Valves:

   Ball valves, 2 inches and smaller, for chemical or water service shall be Schedule 80 full bore design, true union type. Where used in potable water service, the valve shall be ANSI/NSF-61 certified. Valves shall be constructed from CPVC Type IV, ASTM D1784 Cell Classification 23447 and rated for a pressure of 150 psi at a temperature of 105°F and 235 psi at a temperature of 73°F. All O-rings shall be EPDM or FKM as required for the

compatibility with the chemical service and seats shall be constructed of PTFE. All valve components shall be replaceable. Valves for sodium hypochlorite and hydrogen peroxide service shall include vented balls. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

7. Type 7—True Union PVC Ball Valves:

Ball valves, 3 inches and smaller, for chemical or water service shall be Schedule 80 full bore design, true union type. Where used in potable water service, the valve shall be ANSI/NSF-61 certified. Valves shall be constructed from PVC Type I, ASTM D1784 Cell Classification 12454 and rated for a pressure of 150 psi at a temperature of 105°F and 235 psi at a temperature of 73°F. All O-rings shall be EPDM or FKM as required for the compatibility with the chemical service and seats shall be constructed of PTFE. All valve components shall be replaceable. Valves for sodium hypochlorite and hydrogen peroxide service shall include vented balls. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

D. Globe Valves, Angle Valves, Hose Valves, Hose Bibbs, and:

1. Type 1—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.

2. Type 2—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, ASTM B584 (Alloy C83600), or ASTM B198 (Alloy C87600). 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.

3. Type 3—Brass or Bronze Angle Hose Valves 1 1/2 and 2 1/2 Inches (UL Listed):

Angle-type hose valves of sizes 1 1/2 and 2 1/2 inches shall be UL approved complying with UL 668, cast or forged brass or bronze, with handwheel. Inlet threads shall be female NPT. Outlet hose threads shall be male national standard fire hose (MNST). Minimum pressure rating shall be 300 psi. Provide caps with chains for the outlet. Products: Fire Protection Products, Inc. Series 07, National Fire Equipment, Guardian Fire Equipment Model 5000, NIBCO T-331-HC, American Fire Hose and Cabinet Series 400, or equal.

4. Type 4—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.

E. Check Valves:

1. Type 1—Bronze Check Valves 3 Inches and Smaller:

Check valves 3 inches and smaller shall be wye pattern, bronze, ASTM B61, B62, or B584 (Alloy C83600). Ends shall be female threaded, ASME B1.20.1. Disc shall be bronze, swing type.

Check valves 3 inches and smaller shall be Class 125, wye pattern, horizontal swing, conforming to MSS SP-80. Ends shall be female threaded, ASME B1.20.1. Minimum working pressure shall be 200 psi CWP at a temperature of 150°F. Materials of construction shall be as follows:

Component	Material	Specification
Body, bonnet, disc hanger	Bronze	ASTM B584, Alloy C87850
Hinge pin, hanger nut, seat disc nut, seat disc washer	Stainless steel	Type 304 or 316
Disc holder	Bronze	UNS C69300 or C87850
Seat disc	PTFE	—

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 be Nibco T-413-Y-LF or equal.

2. Type 3—Bronze Check Valves 2 Inches and Smaller for Reciprocating Air Compressors:

   Check valves 2 inches and smaller shall be Class 300, bronze, ASTM B61. Ends shall be female threaded ASME B1.20.1. Disc shall be Type 420 stainless steel or bronze (ASTM B61). Minimum pressure rating shall be 250 psi at 150°F. The disc shall provide air cushioning action of the compressor. Provide a disc guide to prevent cocking of the disc. The caps shall anchor the disc guide in alignment with disc travel. The bodies shall have pipe threads and clearances at ends of threads sufficient to permit tight pipe connections, precluding the possibility of pipe ends jamming against diaphragms, distorting seats, or choking the flow. Valves shall be Midwest Control Devices Series MCCB, Lunkenheimer Figure 1616, or equal.

3. Type 4—Cast-Iron Swing Check Valves 3 Inches and Larger, Class 125:

   Swing check valves, 3 inches and larger, shall be iron body, bronze mounted complying with AWWA C508 with the following materials of construction.

Description	Material	Specification
Disc or clapper seat ring and valve body seat ring	Bronze or brass	ASTM B62 or B584 (Alloy C84400 or C87600)
Body and cap (bonnet)	Cast iron	ASTM A126, Class B
Disc and hinge or arm (valves 4 inches and smaller)	Bronze	ASTM B62 or ASTM B584 (Alloy C84400)
Disc and hinge or arm (valves larger than 4 inches)	Cast iron or bronze	ASTM A126, Class B; ASTM B62.
Hinge pin	Stainless steel	Type 303, 304, or 410 stainless
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Internal fasteners and accessories	Bronze or Type 304 or 316 stainless steel	

Bronze or brass components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum 0.25% (potable use)
Copper + Nickel + Silicon	83% minimum

Ends shall be flanged, Class 125, ASME B16.1. Minimum valve working pressure shall be 150 psi. Provide check valves with outside lever.

The shop drawing submittal shall include a detail showing how the hinge pin extends through the valve body. Show packing gland, hinge pin gland, cap, and other pieces utilized.

Valves shall be M&H Style, Clow or equal.

4. Type 5—Cast-Iron Swing Check Valves 2 1/2 Inches and Larger for Fire Protection Service:

Swing check valves of sizes 2 1/2 through 12 inches for fire protection service shall be UL listed, FM approved, rated for at least 175 psi nonshock, cold water. Ends shall be flanged, Class 125, ASME B16.1. Materials of construction shall be as follows:

Description	Material	Specification
Body and cap	Cast iron	ASTM A126, Class B
Disc	Bronze or cast iron	ASTM B62; ASTM B584, Alloy C83600; or ASTM A126, Class B
Disc bushing, disc ring, and seat ring	Bronze	ASTM B62, or ASTM B584 (Alloy C83600)
Hinge pin	Brass	ASTM B16 or ASTM B21

Valves shall be Stockham G-939, Walworth Figure 8883 F, Nibco F-908, or equal.

5. Type 6—Swing Check Valves 10 Through 66 Inches With Controlled Closing Using Bottom-Mounted Hydraulic Buffer:

Controlled closing swing check valves shall be iron body with the following materials of construction:

Description	Material	Specification
Disc or clapper seat ring	Buna-N	
Valve body seat ring	Aluminum bronze	ASTM B148
Body and cap (bonnet)	Cast iron	ASTM A126, Class B
Disc and hinge or arm	Ductile iron	ASTM A536
Shaft and hinge pin	Stainless steel	Type 303, 304, or 410
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Buffer rod	Stainless steel	ASTM A582: Type 303, 304, or 410

Ends shall be flanged, Class 125, ASME B16.1. Minimum valve working pressure shall be 150 psi. Provide check valves with outside lever and weight.

The cushion swing check valve shall conform to AWWA C508. Provide integral flanges (not wafer). The body shall have a flush and drain hole. The seat shall be locked in place with stainless steel lock screws and be field replaced without the use of special tools. The shaft shall be one piece, extending through both sides of the body with a lever and weight mounted on each side. The disc shall utilize a double clevis hinge to prevent disc tipping and be connected to a disc arm. The disc arm assembly shall be suspended from the shaft. The valve shall have a bottom hydraulic buffer to permit free open but positive nonslam control closure of the disc. The hydraulic buffer shall make contact with the disc during the last 10% of closure to instantly control the valve disc until shutoff. The last 10% of closure shall be externally adjustable and variable. The line media to the buffer must be separated by a combination pressure sensing, oil/water separator device to protect the buffer cylinder against corrosion from the main line media. The hydraulic buffer assembly shall be removable from valve without need to remove the entire valve from the pipeline.

Cylinders shall be of tie-rod or bolted-flange construction and shall have a pressure rating of 150 psi minimum, as determined by National Fluid Power Association Specification T3.6.8. Cylinder mounting dimensions shall comply with National Fluid Power Association Specification T3.6.8 regarding mounting and physical dimensions with slight modifications where required to adapt to the valve cylinder mounting. Construction materials shall incorporate a design factor of safety of 4:1 based on tensile strength.

Cylinder barrels, heads, and caps shall be AISI Type 304 or 316 stainless steel, or bronze. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum 0.25% (potable use)
Copper + Nickel + Silicon	83% minimum

The shop drawing submittal shall include a detail showing how the hinge pin extends through the valve body. Show packing gland, hinge pin gland, cap, and other pieces utilized.

Valve shall be APCO Series 6000B or equal.

6. Type 7—Cast-Iron Ball Check Valves, 3 Through 14 Inches, Class 125:

   Valve shall consist of a body with a sinking-type hollow steel ball and flanged access port. Design shall be such that the fluid flow forces the ball into a receiving cavity in the valve. When the fluid flow stops, the ball shall fall out of the cavity into a rubber seat in the body to shut off flow. Valve shall be suitable for vertical upward or horizontal flow conditions. Body material shall be cast iron (ASTM A48 or A126) with 15-mil fusion bonded epoxy lining and coating per AWWA C550. Provide nitrile coating on ball. Provide Type 316 stainless steel fasteners. Flanges shall be Class 125 per ASME B16.1. Products: Flygt Corporation ball check valve, Flomatic Corporation Model 408, or equal.

7. Type 8—Slanting Disc Check Valves With Controlled Opening and Closing, Class 125:

   Slanting disc check valves of sizes 6 through 60 inches shall have materials of construction as described below:

Component	Material	Specification
Body	Cast or ductile iron	ASTM A126, Class B or ASTM A536, Grade 65-45-12
Seat ring and disc ring	Bronze	See paragraph below
Pivot pins	Stainless steel	ASTM A582, Type 303 or 304
Bushings	Stainless steel	ASTM A269, Type 304 or 316
Oil reservoirs	Stainless steel	AISI Type 316

Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum 0.25% (potable use)
Copper + Nickel + Silicon	83% minimum

Ends shall be flanged, ASME B16.1, Class 125. The body shall be of two-piece construction, bolted at the center to hold the seat at angle of 55 degrees. The area throughout the valve body shall equal the full pipe area.

Provide top-mounted hydraulic dashpot to control valve opening and closing. Dashpot shall have a control valve to adjust the speed of the opening and closing cycles. Time spreads shall be adjustable 5 to 30 seconds. Provide oil-filled dashpots to operate the opening and closing arrangement. The reservoir for the opening cycle shall contain pressurized air and shall have a 3-inch pressure gauge and pneumatic fill valve.

Provide oil-fitted bottom buffer to control valve closing (adjustable one to five seconds) over the last 10% of the closing range.

Valve shall be APCO Series 800, Val-Matic Series 9600 or 9800 or equal.

8. Type 9—Rubber Flapper Swing Check Valves (3 Through 24 Inches):

   Valves shall consist of body, flapper, and bolted cover. Operating pressure shall be at least 175 psi at a temperature of 212°F. Valve seat shall be set at an angle of 35 to 45 degrees to the centerline of the pipe. Ends shall be flanged, ASME B16.1, Class 125. Body and cover shall be cast iron (ASTM A48, Class 30, or ASTM A126, Class B). Flapper shall consist of a steel disk insert and a steel bar hinge bonded to the metal pieces. Provide O-ring seal bonded onto the disk. Lining shall have a hardness of 50 to 60 durometer, Shore A. Cover bolts shall be Type 316 stainless steel.

   Products: APCO Series 100R, Val-Matic Series 500, or equal.

9. Type 10—Duckbill-Shaped Check Valves, 1 Through 54 Inches, Class 125:

   Valve shall consist of a contoured rubber body with a duckbill sleeve-type exit. The body entrance shall be round, with a connecting Class 125 ASME B16.1 rubber flange to match the connecting pipe.. Provide synthetic fabric reinforcement. Provide stainless steel backing rings on the rubber body flanges. The valve shall open at a differential pressure of 2 inches of water column and shall close under a no-flow condition. Minimum body pressure

rating shall be 50 psi. Maximum backpressure: 10 psi. Products: Red Valve Company “Tideflex” Model 35 or equal.

10. Type 11—Silent Check Valve 3 Inches and Larger:

Silent check valves, 3 inches and larger, shall be bronze mounted globe style. The seat and plug shall be hand replaceable in the field. Provide resilient seat. Flow area through valve shall be equal to or greater than the cross sectional area of the equivalent pipe size. Valve plug shall be center guided with a through integral shaft and spring loaded for silent shutoff operation. Ends shall be flanged Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast Iron	ASTM A48, Class 30, or ASTM A126, Class B
	Ductile Iron	ASTM A536, Grade 60-45-10
Plug and seal	Bronze	ASTM B62 or B584 (Alloys C83600 or C87600)
Spring	Stainless steel	Type 316 stainless

Valve shall be APCO Series 600 or equal.

11. Type 12 – CPVC Ball Check Valves

Valve bodies and balls shall be fabricated with chlorinated polyvinyl chloride (CPVC), or polyvinylidene fluoride (PVDF), as recommended by the manufacturer for the service indicated. Valves shall include unions with socket connections. Seals shall have Viton O-rings and valve design shall minimize possibility of the balls sticking or chattering. Valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

12. Type 13 – PVC Ball Check Valves

Valve bodies and balls shall be fabricated with polyvinyl chloride (PVC), or polyvinylidene fluoride (PVDF), as recommended by the manufacturer for the service indicated. Valves shall include unions with socket connections. Seals shall have Viton O-rings and valve design shall minimize possibility of the balls sticking or chattering. Valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

PART 3 EXECUTION

3.1 VALVE SHIPMENT AND STORAGE

A. 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.

B. 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.

C. 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.

D. 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.

E. 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.

F. 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.

3.2 FACTORY PRESSURE TESTING

A. 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.

3.3 INSTALLING VALVES - GENERAL

A. 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.

B. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault or building walls, or trench walls.

C. 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.

D. 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

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

3.4 INSTALLING EXPOSED VALVES

A. 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.

B. 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.

3.5 INSTALLING BURIED VALVES

A. Connect the valve, coat the flanges and place and compact the backfill to the height of the valve stem.

B. Connect the valve, coat the flanges, apply polyethylene encasement, and place and compact the backfill to the height of the valve stem.

C. Place block pads under the riser pipe to maintain the valve box vertical during backfilling and repaving and to prevent the riser pipe from contacting the valve bonnet.

D. Secure the riser pipe with backfill and compact. Install the valve box and pour the concrete collar. In pavement areas pour the collar to 2 inches below the finished pavement grade to allow asphalt concrete to be placed over the collar. In non-paved areas, place the collar to the top of the valve box.

3.6 FIELD COATING BURIED VALVES

A. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 09 90 00, System No. 24.

B. Wrap buried metal valves 6 inches and in two layers of polyethylene conforming to AWWA C105, 8 mils in thickness each. Pass the two sheets of polyethylene under the valve and the coated flanges or joints with the connecting pipe and draw the sheets around the valve body, the valve bonnet, and the connecting pipe. Secure the sheets with plastic adhesive tape about the valve stem below the operating nut and about the barrel of the connecting pipe to prevent the entrance of soil. Fold overlaps twice and tape. Backfill the valve with care to avoid damaging the polyethylene.

3.7 ASSEMBLING JOINTS

A. 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.

B. 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.

3.8 INSTALLING EXTENSION STEM GUIDE BRACKETS

A. 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.

3.9 MOUNTING GEAR ACTUATORS

A. 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.

3.10 FIELD INSTALLATION OF GEAR ACTUATOR

A. Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

3.11 VALVE FIELD TESTING

A. Test valves for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 40 05 15 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.

B. 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.

C. 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 SECTION

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SECTION 40 05 60

AIR-RELEASE AND VACUUM-RELIEF VALVES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials and installation of air and vacuum valves, air-release valves, combination air-release valves, slow-closing air and vacuum valves, vacuum-relief valves, and slow-closing combination air-release valves for water and sewage service.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 33 05 00 – Piping and Fittings

C. Section 33 13 00 – Disinfection of Water System

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME)

B. American Society for Testing and Materials (ASTM)

C. American Water Works Association (AWWA)

D. Food and Drug Administration (FDA)

E. National Electrical Manufacturers Association (NEMA)

F. Occupational Safety & Health Administration (OSHA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data and detail drawings showing all valve parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings.

PART 2 PRODUCTS

2.1 VALVE IDENTIFICATION

A. Valves are identified in the drawings by size, category and type number. For example, a callout in the drawings of a 3/4" Type 1 Air Release Valve refers to a

Type 1 Air Release Valve in these specifications, which is a 150-psi ¾" or smaller air-release valve.

2.2 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES

A. See Section 40 05 00 and specification for the pipe to which the valve is attached.

2.3 VALVE DESIGN-AND OPERATION

A. Valve design shall comply with AWWA C512, except as modified herein. Class 150 valves shall have a maximum working pressure of at least 150 psi.

B. Air-Release Valves for Water Service:

1. Air-release valves for water service 3/4 inch and smaller shall be of the direct-acting type or lever type. Valves larger than 3/4 inch shall have a float-actuated compound lever with linkage mechanism to release air.

2. Air-release valves of sizes 1 and 2 inches shall incorporate a body with flanged top cover and replaceable orifice and a synthetic rubber needle or disc actuated by the float and linkage mechanism. Top cover shall include a 1/2-inch threaded port with bronze plug. Body shall include a 1/2-inch threaded drain port near the bottom with a bronze plug.

C. Air and Vacuum Valves for Water Service:

1. Air and vacuum valves for water service shall have a body with a flanged top containing the air-release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat.

2. Air and vacuum valves 3 inches and smaller shall have 1/2-inch threaded ports with bronze plugs in the top cover and near the bottom of the valve body. Air and vacuum valves larger than 3 inches shall have a 1-inch threaded drain outlet with bronze plug near the bottom of the valve body and a 1-inch threaded port with bronze plug on the side of the valve body above the minimum water level in the valve which forces the float against the valve seat.

D. Combination air valves 3 inches and smaller shall have a float with lever arm to actuate a poppet valve. A needle shall be attached to the float arm. The poppet valve shall serve to admit large quantities of air when the pipeline drains. The needle shall serve to release small quantities of air as the pipeline fills or as air accumulates in the pipeline.

Combination air valves 4 inches and larger for water service shall consist of an air and vacuum valve with an air-release valve attached to it or integral with it. Connect the attached air-release valve to the air and vacuum valve with standard weight steel piping (ASME B36.10) and an isolation valve if required.

E. Slow-closing air and vacuum valves for water service shall have a float assembly and large venting orifice to exhaust large quantities of air from pipelines when being

filled and to admit large quantities of air when pipelines are being drained. Valve assembly shall incorporate a perforated water diffuser or surge check valve on the inlet to prevent the water column entering the valve from slamming the float shut.

F. Slow-closing combination air valves for water service shall consist of an air and vacuum valve with an air-release valve integral or attached to it. The air and vacuum valve shall incorporate a perforated water diffuser or surge check valve on the inlet to prevent the water column from slamming the float shut. Connect the attached air-release valve to the air and vacuum valve with standard weight steel piping (ASME B36.10) and an isolation valve if required.

G. Air and Vacuum Valves for Vertical Turbine Pump Service:

1. Air and vacuum valves for vertical turbine pump service (3 inches and smaller) shall have a float assembly. The discharge orifice shall have a double-acting throttling device to restrict air venting; it shall fully open to allow unrestricted air entry when the pump is shut down. Valve shall have a body with flanged top containing the air-release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat.

2. Valves 3 inches and smaller shall include the following features:

a. Water diffuser around the float to break up the incoming water column before contacting the float.

b. Double-acting throttling device that restricts airflow when the pump is started and opens fully when the pump is stopped.

H. Air-release valves and air and vacuum valves for sewage service shall have elongated cylindrical chambers designed to release entrained air and sewage gases through an air-release orifice. The valve body and float shall withstand a 500 psig shell pressure. Provide:

1. 1/2-inch clearance around the float in the chamber.

2. Minimum size 1/2-inch isolation valve, quick disconnect coupling, and backflushing hose.

3. Blowoff port and valve at the bottom of the chamber.

I. Combination Sewage Air Valves: Combination sewage air valves shall vent accumulating gases during system operation through one orifice and shall allow large volumes of air to enter or escape the pipeline during filling operations through a second orifice. Valves shall have elongated cylindrical chambers designed to release entrained air and sewage gases through two air-release orifices. The valve body and float shall withstand a 500 psig shell pressure. The same general requirements shall apply as specified for air and vacuum valves. Provide:

1. 1/2-inch clearance around the float in the chamber.

2. Minimum size 1/2-inch isolation valve, quick disconnect coupling, and backflushing hose.

3. Blowoff port and valve at the bottom of the chamber.

4. Each sewage air valve shall be furnished with the following backwash accessories, fully assembled on the valve:

   a. Inlet shutoff valve.

   b. Flush valve.

   c. Clear water inlet valve.

   d. Rubber supply hose.

   e. Quick disconnect couplings.

2.4 MATERIALS OF CONSTRUCTION

A. Materials of construction for air-release, air and vacuum, and combination air valves for water service shall be as follows:

Item	Material	Specification
Body and cover	Cast iron	ASTM A48, Class 35; or ASTM A126, Class B
Float, lever or linkage, air-release mechanism, poppet, guide rod, guide bushings, fasteners, other internal metal parts	Stainless steel	AISI Type 304
Plugs	Bronze	See paragraph E below
Seat, plunger, needle	Buna-N	–

B. Materials of construction for diffusers or surge check valves for slow-closing air and vacuum valves shall be as follows:

Item	Material	Specification
Body	Cast iron	ASTM A48, Class 30 or ASTM A126, Class B
Seat, plug, bushing	Bronze	See paragraph E below
Spring, retaining ring, seat retaining ball, fasteners, other internal metal parts	Stainless steel	AISI Type 304
Gasket between diffuser or surge check valve and valve	Cloth-inserted rubber, 1/8 inch thick	Crane Co., Style 777 or equal

C. Materials of construction for air-release, air and vacuum valves, and combination air valves for sewage service shall be as follows:

Item	Material	Specification
Body, cover, baffle	Cast iron	ASTM A48, Class 35 or ASTM A126, Class B
	Stainless steel	AISI Type 316
Float plug, float guide, stems, fasteners, internal parts	Stainless steel	AISI Type 316
Seat, plunger, needle	Buna-N	–

D. Materials of construction for vacuum-relief valves for pipes and tanks shall be as follows:

Item	Material	Specification
Body	Cast iron	ASTM A126, Class B
Plug	Bronze	ASTM B584, Alloy C83600
Hood	Steel	AISI 1020
Seat	Buna-N	–
Spring	Stainless steel	ASTM A313, Type 302
Seat retaining screws, ring plate bolts and nuts, hood retaining screws, hood washers, other internal metal parts	Stainless steel	AISI Type 304

E. 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.

F. Body and cover bolts, nuts, and cap screws shall be carbon steel, ASTM A307.

2.5 VALVE END CONNECTIONS

A. Valves 3 inches and smaller shall have threaded ends. Valves 4 inches and larger shall have flanged ends.

B. Flanges for Class 150 valves shall comply with ASME B16.1, Class 125. Threaded ends shall comply with ASME B1.20.1.

2.6 VALVES

A. Air Release Valves

1. Type 1--Air-Release Valves, 3/4 Inch and Smaller: Valves shall have an operating pressure of 150 psi. Unless otherwise noted on the plans, the orifice sizes shall be 3/32 or 1/8 inch for 1/2-inch valves and 1/8 inch for 3/4-inch valves. Valves shall be APCO Series 50; Val-Matic Model 15A Series or equal.

2. Type 2--Air-Release Valves, 1 and 2 Inches, Class 150: Valves shall have a maximum working pressure of 150 psi. Unless otherwise noted on the plans, the orifice size shall be 3/16 or 1/4 inch. Valves shall be APCO Series 50, Val-Matic Model 15A Series or equal.

3. Type 3--Sewage Air-Release Valves, 2 Through 4 Inches, Class 150: After entraining air escapes through the orifice, the orifice shall be closed by a needle on a compound lever mechanism to prevent the escape of sewage. The orifice shall remain closed until more gas accumulates and the cycle automatically repeats. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall have an operating pressure of at least 150 psi. Valves shall be APCO Model 400, Val-Matic Model 48 and 49 Series, or equal.

B. Air and Vacuum Valves

1. Type 1--Air and Vacuum Valves, ½" Through 4 Inches, Class 150: Valves shall be APCO Series 141, Val-Matic Model 100S Series or equal.

2. Type 2--Air and Vacuum Valves for Vertical Turbine Pump Service, 6 Inches and Smaller: Valves shall be APCO Series 140DAT or Series 1900, Val-Matic Model 100ST and 106 SS Series or equal. Valve shall incorporate an air-release valve, Type 1.

3. Type 3--Slow-Closing Air and Vacuum Valves, 4 Through 16 Inches, Class 150: Valves shall be APCO Series 1900, Val-Matic Surge Suppression Air Valves, or equal.

4. Type 4--Sewage Air/Vacuum Valves, 2 Through 12 Inches, Class 150: Valve shall allow unrestricted venting or reentry of air during filling or draining of pipelines. Valve shall incorporate two floats, or a float and a plug connected

by a common float guide, to maintain an air gap between the two. Top float or plug shall rest against the orifice seat while the valve chamber contains liquid. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall be APCO Series 401, Val-Matic Model 301 Series, or equal.

C. Combination Air Valves

1. Type 1--Combination Air Valves, 1 Through 4 Inches, Class 150: Unless otherwise noted on the plans, the minimum orifice size for the air-release valve shall be 3/16 inch. Combination air-release valves shall be APCO Series 143C, Val-Matic Model 201C Series or equal.

2. Type 2--Slow-Closing Combination Air Valves, 4 Through 16 Inches, Class 150: Unless otherwise noted on the plans, the minimum orifice size for air-release valve shall be 1/4 or 3/16 inch. Combination air-release valves shall be APCO Series 1700, Val-Matic Surge Suppression Dual Body Air Valves, or equal.

3. Type 3--Sewage Combination Air Valves, 1 Through 4 Inches, Class 150: Valve system shall allow unrestricted venting or reentry of air during filling or draining of pipelines and to vent small pockets of air which collect in the pipeline. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall be APCO Series 440 or equal.

D. Vacuum-Relief Valves

1. Type 1--Vacuum-Relief Valves for Pipes and Tanks, 3 Through 12 Inches, Class 150: Vacuum-relief valves shall be capable of allowing air into pipes and tanks while they are being drained. Valve shall be globe-body style with flanged end per ASME B16.1, Class 125. Pressure rating shall be at least 150 psi. Provide a spring-loaded plug which is normally closed and which opens to allow air to enter. Plug shall be center-guided at both ends and shall be normally closed by means of a spring and shall open when the vacuum or differential pressure exceeds 0.25 psi. Valves shall be APCO Model S1500, Val-Matic Model 1800VB Series or equal.

PART 3 EXECUTION

3.1 SERVICE CONDITIONS

A. Valves shall seat driptight at the specified seating pressure.

3.2 FACTORY TESTING

A. Test each valve per AWWA C512, Section 5 and the following.

B. Hydrostatically test the pressure-containing parts at the factory 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, provide an additional operational test per AWWA C512, Section 5 for each affected valve.

C. 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.

3.3 PAINTING AND COATING

A. Coat cast-iron valves the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 09 90 00. Apply the specified prime and intermediate coats at the place of manufacture. Finish coat shall match the color of the adjacent piping.

B. Coat interior surfaces of cast-iron valves at the place of manufacture per Section 09 90 00. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.

C. Alternatively, line and coat valves with fusion-bonded epoxy. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.

3.4 SHIPMENT AND STORAGE

A. Identify the equipment with item and serial numbers and pipeline station. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number and project equipment pipeline station or 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.

B. 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.

C. 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 pump manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

D. 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 pump manufacture prior to shipping.

E. Clearly identify lifting points and lifting lugs on the valves. Identify the recommended lifting arrangement on boxed equipment.

3.5 INSTALLATION

A. 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.

B. 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.

C. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the valves.

D. Do not spring flanges of connecting piping into position. Separately work connecting piping systems into position to bring the piping flanges into alignment with the matching valve flanges. Do not move valves to achieve piping alignment. Do not use electrical heating stress relieving to achieve piping alignment.

E. Line up pipe flange bolt holes with valve nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

F. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

3.6 VALVE FIELD PRESSURE TESTING

A. Test valves at the same time that the connecting pipelines are pressure tested. See Section 40 05 00 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

END SECTION

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SECTION 40 05 70

GLOBE CONTROL VALVES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials and installation of globe-style diaphragm-actuated control valves acting as pump control valves, pressure valves, pressure-relief valves, pressure-sustaining valves, flow control valves, altitude valves and surge control valves.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 00 – Pipe and Fittings

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME)

B. American Society for Testing and Materials (ASTM)

C. American Water Works Association (AWWA)

D. Food and Drug Administration (FDA)

E. National Electrical Manufacturers Association (NEMA)

F. Occupational Safety & Health Administration (OSHA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Submit dimensional drawings for each valve.

C. Submit materials of construction for all valve parts including reference standard and grade. Indicate NSF-61 certification where valve will be used in drinking water service.

D. Submit details of valve pilot control system including solenoid valves where used.

E. Provide cavitation curve clearly indicating the acceptable inlet and outlet pressures for the design flow range.

1.5 MANUFACTURERS' SERVICES

A. Provide equipment manufacturers' 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 valves and instructing the Owner's personnel in the operation and maintenance of the valves.

PART 2 PRODUCTS

2.1 VALVE IDENTIFICATION

A. Valves are identified in the drawings by size and type number. For example, a callout in the drawings of a 10-inch Type 1 valve refers to a 10-inch pressure reducing valve.

2.2 MANUFACTURERS

A. Diaphragm-actuated control valves shall be manufactured by Cla-Val Company; Singer Valve Company; or equal.

2.3 VALVE DESIGN

A. The valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern conforming to AWWA C530.

B. The valve shall consist of three major components: the body with seat installed, the cover with bearing installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

C. The pilot system shall be manufactured and furnished by the same company that manufactures the main valve.

D. Repairs and modifications other than the replacement of the main valve body shall be possible without removing the main valve from the line.

E. All valves shall be designed to open and close smoothly at a controlled rate to prevent pressure surges.

2.4 MATERIALS OF CONSTRUCTION

A. Valves serving in drinking water service shall be certified to ANSI/NSF-61 and shall comply with California AB1953 – no lead.

B. Valve body and cover shall be ASTM A536 ductile iron. The disc retainer shall be cast iron or ductile iron.

C. The disc guide, valve seat, and bearing shall be bronze or stainless steel as required by the application.

D. The disc shall be Buna-N rubber. The diaphragm shall be constructed of a non-wicking nylon fabric bonded with Buna-N rubber.

E. The stem, nut, spring, and fasteners shall be 304 or 316 stainless steel.

2.5 VALVE END CONNECTIONS

A. Valves 2 inches and smaller shall have threaded ends. Valves larger than 2 inches shall have flanged ends.

B. Flanges for ductile-iron valves shall be ductile iron, same grade as the valve. Flanges shall be flat face.

C. Threaded ends shall comply with ASME B1.20.1.

D. Do not provide raised-face mating flanges on the connecting piping.

2.6 INTEGRAL CHECK FEATURE

A. Where indicated under “Service Conditions”, the valve pilot control system shall be configured so that the valve acts as a check valve permitting flow in only the forward direction.

2.7 LIMIT SWITCHES

A. Limit switches shall be included with the valve when indicated in this specification under service conditions.

B. The limit switch assembly shall be designed to provide electrical switching indication of the position of the valve. The switch shall be mechanically actuated by the opening or closing of the valve on which it is mounted.

C. A stainless steel actuating stem with a swivel adapter shall be fastened directly to the main valve stem. The stem shall move through an adapter and gland with two O-ring seals allowing the stop collar to actuate the switch. The switch shall be in a weather proof enclosure.

D. The single pole, double-throw switch shall be capable of being connected to either open or close a circuit when actuated.

2.8 POSITION INDICATOR

A. A position indicator shall be included with the valve when indicated in this specification under service conditions.

B. The position indicator shall consist of a brass indicator rod fastened to the main valve stem which moves up and down inside a clear Pyrex tube contained in a bar brass housing open on two sides to permit clear vision of the brass indicator rod.

2.9 POSITION TRANSMITTER

A. Where indicated under “Service Conditions”, the valve shall be equipped with a position transmitter designed to electronically monitor the valve position and generate a proportional 4-20 mA analog output signal.

B. The position transmitter shall be enclosed in a rugged weather resistant (NEMA 6 or better) sealed aluminum and stainless steel housing.

2.10 FLOW METER

A. Where indicated under “Service Conditions”, the valve shall be equipped with an integral vortex shedding insertion type flow meter. Meter shall include a threaded swivel insert with measurement cylinder, fittings and electronics housing fabricated from stainless steel. The meter shall have no moving parts.

B. Flow meter shall be installed in a tap on the inlet side of the main valve.

C. Flow meter shall be accurate to +/- 2% of full scale or better.

D. The flow meter shall be powered by 12/24 VDC. Flow meter shall be 4-20 mA loop powered and capable of communicating with SCADA. The flow data signal shall be converted to 4-20mA unless pulse communications is specifically called for under “Service Conditions”.

E. Flow meter shall be Cla-Val X144 or equal.

2.11 ANTI-CAVIATION TRIM

A. The valve shall be provided with anti-cavitation trim where called for in this specification or where the manufacturer determines that such trim is required for reliable operation under the service conditions described in this specification.

B. Anti-cavitation trim shall consist of a stainless steel radial slotted disc guide and seat.

2.12 VALVES

A. Type 1 – Class 150 Pressure-Reducing Valves:

1. The pressure reducing valve shall maintain a constant downstream pressure regardless of changing flow rate and/or inlet pressure. The pressure-reducing pilot control system shall be a direct-acting, adjustable, spring loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm, and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves 3” and smaller. The pilot control shall have a

second downstream sensing port which can be utilized to install a pressure gauge.

2. Pilot system adjustment range shall be as shown under “service conditions”. If not specifically indicated under “service conditions” the manufacturer shall provide their recommended adjustment range.

3. Valve shall be Cla-Val 90 series or equal.

B. Type 2 – Class 150 Pressure-Relief and Pressure-Sustaining Valves:

1. The valve shall maintain a constant upstream pressure by bypassing or relieving excess pressure and shall maintain close pressure limits without causing surges. If upstream pressure decreases below the spring setting, the valve shall close.

2. The pressure relief pilot shall be a direct-acting, adjustable, spring-loaded, diaphragm valve designed to permit flow when controlling pressure exceeds the adjustable spring setting. The pilot control is normally held closed by the force of the compression on the spring above the diaphragm and it opens when the pressure acting on the underside of the diaphragm exceeds the spring setting. Pilot control sensing shall be upstream of the pilot system strainer so accurate control may be maintained if the strainer is partially blocked.

3. Pilot system adjustment range shall be as shown under “service conditions”. If not specifically indicated under “service conditions” the manufacturer shall provide their recommended adjustment range.

4. Valve shall be Cla-Val 50 series or equal.

C. Type 3 – Class 150 Flow Control Valves:

1. The rate of flow control valve shall limit flow to the preset maximum rate regardless of changing line pressure.

2. The pilot system shall be a direct acting diaphragm valve designed to close when the controlling differential exceeds the adjustable spring setting. The pilot control is normally held open by the force of the compression on the spring above the diaphragm and it closes when the pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall contain a fixed orifice. No variable orifices shall be permitted.

3. A stainless steel orifice plate flange assembly shall be included and mounted one to five pipe diameters downstream. The contractor shall connect the sensing line between the pilot system and the orifice plate.

4. Orifice plate shall be sized by the manufacturer for reliable and accurate operation at the flow rate or range of flow rates specified under “service conditions”.

5. Valve shall be Cla-Val 40 series or equal.

D. Type 4 – Class 150 Altitude Control Valves (Backpressure With Solenoid):

1. The altitude valve shall control the high water level in a reservoir without the need for floats or other mechanical devices. The valve hydraulic pilot system shall be enabled when the solenoid is powered until the shut-off point of the hydraulic pilot control is reached. The valve shall be designed for one-way flow only.

2. The hydraulic pilot control shall be of a diaphragm-actuated, three-way type that operates on the differential force between the height of the water in the reservoir and an adjustable spring-load. The spring-load shall be an arrangement of smaller springs on a plate within the control. When actuated, the pilot control shall vent the cover of the main valve to atmosphere through the internal working of the pilot control to open the valve. When the desired level in the reservoir is reached, the static height of the tank shall head through a Contractor furnished sensing line connected directly to the reservoir or as shown on the drawings.

3. The valve hydraulic pilot control shall be configured to modulate the valve to maintain upstream pressure (backpressure valve) within close limits to prevent over drawing system supply while filling reservoir.

4. The electronic pilot control shall be a three-way solenoid valve controlled by an external electrical power source. The pilot system shall include strainers, shut-off cocks and manual operator. Opening and closing speed control needle valves shall be utilized so as to prevent surging of the system on start-up and shut-down. Solenoid shall have a NEMA IV enclosure.

5. Valve shall be Cla-Val series 210 or equal.

E. Type 5 - Class 150 Electronic Control Valve:

1. The electronic control valve shall modulate based on electronic signals received from SDADA. Control shall be based on the remote control of two solenoids which alternately apply or relieve pressure to the diaphragm chamber to position the main valve. Both valves shall be normally closed (energized to open), 120 or 240 VAC with NEMA 4 enclosures.

2. A manual system to bypass the solenoids shall be provided.

3. Valve shall be Cla-Val series 131 or equal.

2.13 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be as specified for the piping to which the valves are connected.

B. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.14 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2.15 SPARE PARTS

A. None.

PART 3 EXECUTION

3.1 SHIPMENT AND STORAGE

A. Ship and deliver valves in accordance with AWWA C530, Section 6 and as follows.

B. Provide threaded openings with nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping.

C. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around valve bonnet, pilot housing, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.

D. Protect the valve and pilot system from weather and the accumulation of dirt, rocks, and debris. Also, see the manufacturer's specific storage instructions.

3.2 COATING

A. Valve shall be coated with fusion bonded expoxy coating applied in accordance with AWWA C116.

3.3 VALVE SERVICE CONDITIONS

A. Valve service conditions shall be as shown below.

B. Valve Tag Number(s): Backwash Supply 30-FCV-011

Valve Size	8 inches
Valve Type	Type - 3
Specific Model Number	N/A
Minimum Flow	1,000 gpm
Maximum Flow	3,000 gpm
Upstream Pressure Range	40 – 70 psi
Anti-Cavitation Trim	As required
Integral Flow Metering	No
Position Transmitter	No

Position Indicator	Yes
Integral Check Feature	Yes
Limit Switch	No

C. Valve Tag Number(s): Bypass Flow Control Valve 30-FCV-002

Valve Size	8 inches
Valve Type	Type - 3
Basis Part Number	N/A
Minimum Flow	500 gpm
Maximum Flow	2,000 gpm
Upstream Pressure Range	60 psi
Downstream Pressure Range	55 psi
Anti-Cavitation Trim	As required
Integral Flow Metering	No
Position Transmitter	No
Position Indicator	Yes
Integral Check Feature	Yes
Limit Switch	No

3.4 VALVE INSTALLATION

A. Remove covers over flanged openings and plugs from threaded openings, after valves have been lifted off the truck and placed at the point to which it will be connected to the adjacent piping.

B. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads as specified in the piping specifications, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

C. Clean threaded joints by wire brushing or swabbing. Apply Teflon® joint compound or Teflon® tape to pipe threads before installing threaded valves. Joints shall be watertight.

D. Handle valves carefully when positioning, avoiding contact or impact with other equipment or vault or building walls.

E. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

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

3.5 VALVE PRESSURE TESTING

A. Test valves at the same time that the connecting pipelines are pressure tested. See Section 40 05 00 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

END SECTION

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SECTION 40 05 75

PIPING AND EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes furnishing and installing markers, labels, tags, and signs for piping, valves, and equipment.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 00 – Piping and Fittings

C. Section 40 05 23 – Valves and Appurtenances

D. Section 40 05 70 – Globe or Angle Pattern Control Valves

E. Section 46 61 21 – Pressure Filters

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME) A13.1

B. American Society for Testing and Materials (ASTM)

C. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Submit list of wording, symbols, letter size, and color coding for all identification.

C. Provide manufacturers catalog literature for each product required.

D. Submit two samples of each product to be used.

E. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Identification shall be by Brady Corporation, Seton, or equal.

2.2 VALVE TAGS

A. Valve tags shall be brass or stainless steel. Plastic tags will not be accepted.

B. Tags shall be 40 mils thick and shall include filled text for easy readability.

C. Lettering shall be stamped letters with character size and words to ANSI A13.1.

D. Valve tags shall be attached using stainless steel beaded chain, jack chain or wire. Nylon ties will not be accepted.

2.3 PIPE MARKERS

A. Pipe markers shall include the service name and flow directional arrows. Labeling shall conform to ASME A13.1.

B. Locate pipe markers at maximum 20 foot centers on straight runs including risers and drops, adjacent to each valve and tee, and at each side of penetration of structure or enclosure.

C. Labels for indoor locations shall be mechanically fastened or self-adhesive vinyl.

D. Labels for outdoor locations shall be UV resistant acrylic plastic

E. Snap-on type markers made of UV resistant acrylic will be accepted for both indoor and outdoor use.

F. Markers attached with nylon ties will not be accepted.

2.4 MECHANICAL EQUIPMENT

A. Label all mechanical equipment with the equipment description and tag number shown on the drawings.

B. Labels shall be a minimum of 1-1/2 inches by 4 inches in size and shall be fabricated of aluminum or fiberglass resistant to UV.

2.5 HAZARDOUS MATERIALS WARNING SIGNS

A. Label all chemical storage tanks and entrances to areas containing chemicals with “diamond” warning signs complying with NFPA 704. Size shall be a minimum of 10-inch square

B. Install 1/8-inch fiberglass wall signs (Brady B-120 or equal). Signs attached to tanks shall be self-adhesive (Brady B-946 or equal).

2.6 AUTOMATIC EQUIPMENT

A. Install automatic start warning signs adjacent to the following equipment. The signs shall include the wording “AUTOMATIC EQUIPMENT – MAY START AT

ANY TIME".

Well pump
Chemical enclosure entrances

2.7 NO SMOKING SIGNS

A. Install "NO SMOKING" sign at the following locations. Sign shall be weather and UV resistant fiberglass with a minimum size of 10 inches by 7 inches.

Chemical enclosure entrances
Standby generator

2.8 UNDERGROUND MARKERS

A. Non-Detectable Underground Markers

1. Material: Polyester
2. Thickness: 0.09 mm thick to ASTM D1593
3. Width: 6 inches
4. Tensile Strength: 7 lb/in to ASTM D638
5. Elongation: 300% to ASTM D638
6. Color to American Public Works Association standards

B. Detectable Underground Markers

Install No. 10 solid-core copper tracer wire

PART 3 EXECUTION

3.1 INSTALLATION OF LABELS AND TAGS

A. Install all tags, signs, and labels in clear view. Pipe markers shall be aligned with axis of pipe.

B. Degrease and clean surfaces to receive adhesive labels prior to application.

C. Install valve tags with corrosion resistant ties to the valve handwheel. Valves in main and branch piping shall be tagged.

D. All valves included in a valve schedule or identified by tag number in the P&ID drawings shall be tagged.

E. All exposed piping shall be labeled and marked with flow direction arrows.

END SECTION

SECTION 40 20 10

PIPE SUPPORTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. All pipe hangers, brackets, supports and accessories for newly installed piping as specified and indicated in the Contract Documents.

B. All labor, materials, equipment and incidentals necessary and required for their completion.

C. Concrete and fabricated steel supports shall be as indicated or specified in other sections or, in the absence of such requirements, as permitted by the Engineer.

1.2 RELATED WORK

A. Section 03 30 10 - Concrete Site Work

B. Section 09 90 00 – Painting and Coating

C. Section 40 05 23 – Valves and Appurtenances

D. Section 40 05 70 – Globe or Angle Pattern Control Valves

E. Section 46 61 21 – Pressure Filters

1.3 REFERENCES

A. Seismic design requirements in applicable codes and regulations.

1.4 QUALITY ASSURANCE

A. Except as modified or supplemented herein, all pipe supports shall comply with the applicable provisions of ANSI/MSS SP-58 AND MSS SP-69.

B. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Data shall include a listing of the intended use and general location of each item submitted.

1.6 DELIVERY, STORAGE AND HANDLING

A. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

PART 2 PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified or indicated on the drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.

B. Pipe support types and application shall comply with Schedule I in paragraph 3.2.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Design Criteria

1. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.

2. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

3. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Pipe supports shall be designed to comply with the applicable seismic requirements in accordance with the seismic design requirements section.

2.3 DIMENSIONS

A. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as scheduled in Schedule II at the end of this section.

2.4 STRUCTURAL DESIGN

A. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

PART 3 EXECUTION

3.1 INSTALLATION

A. Approved anchors shall be used to fasten supports to concrete or masonry. Unless otherwise indicated on the drawings or permitted by the Engineer, piping shall be supported so that the closest distance from pipe wall or insulation covering is at least 1-1/2 inches from the face of walls and at least 3 inches below ceilings.

B. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Those portions of pipe supports which contact dissimilar metals shall be rubber or vinyl coated.

3.2 SCHEDULES

A. SCHEDULE I: Pipe Support Types and Application Schedule:

Description or Location	MSS SP-69 (Note 1)	Other
Hangers		
2-1/2 inch and smaller pipe:		
J-style	5	Elcen "90", Fee & Mason "210", Unistrut "J Hangers", or equal.
clevis	1	Elcen "12B", Fee & Mason "105", ITT Grinnell "65", or equal.
3-inch through 10-inch pipe:		
clevis	1	Elcen "12", Fee & Mason "239", ITT Grinnell "260" for steel pipe; Elcen "12C", Fee & Mason "104", ITT Grinnell "590" for cast iron pipe, or equal.
Concrete Inserts, steel:		
12-inch and smaller pipe	18	Channel 12 ga, galv. 1-5/8" x 1-3/8", min. 8 inches long, anchor lugs on 4" centers, at least three lugs, end caps, and filler strip.
Wall Supports and Frames, steel :		
12-inch and smaller pipe:		
brackets	32, 33	---
prefabricated channels	---	12 ga galv., 1-5/8" x 1-5/8", with suitable brackets and pipe clamps.
offset pipe clamp, (1-1/2 inch and smaller pipe)	---	Galv., 1-1/4" x 3/16" steel with 3/8" bolts.

Description or Location	MSS SP-69 (Note 1)	Other
offset pipe clamp, (2-inch to 3-1/2 inch pipe)	---	Galv., 1-1/4" x 1/4" steel, with 3/8" bolts.
Floor Supports, steel or cast iron:		
6-inch and small pipe	37 with base	---
8-inch through 24-inch pipe	38 with base	--

B. SCHEDULE II: Spacing Schedule

1. Distance between supports shall not be more than that recommended by the pipe manufacturer.

2. Distance between supports shall not be more than that shown on the drawings.

3. Additional supports shall be added as required to prevent visible bowing of pipe.

4. In addition to the spacing requirements listed above, the distance between supports shall not be more than listed in the following schedule.

Type of Pipe	Pipe Support Max Spacing, ft	Max Run Without Expansion Joint, Loop. or Bend, ft	Expansion Joint Max Spacing, ft	Type of Expansion Joint
Ductile Iron, 4" and larger	15	80	80	Note 1
Steel for all services:				
1-1/4 inch and smaller	7	30	100	Note 1
1-1/2 to 4 inch	10	30	100	Note 1
Over 4 inch	15	80	80	Note 1
PVC, Schedule 40				
Smaller than 3”	4	20	60	Note 1

Type of Pipe	Pipe Support Max Spacing, ft	Max Run Without Expansion Joint, Loop. or Bend, ft	Expansion Joint Max Spacing, ft	Type of Expansion Joint
3" and larger	6	20	60	Note 1
PVC Schedule 80				
Smaller than 3”	5	20	60	Note 1
3" and larger	7	20	60	Note 1

Notes:

1. Expansion joint not required in straight run of pipe if overall length does not exceed the maximum run specified in schedule.

END SECTION

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SECTION 40 20 90

PVC AND CPVC PROCESS AND CHEMICAL PIPING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, installation, and testing of PVC and CPVC piping smaller than 4 inches used in process piping and chemical piping.

1.2 RELATED WORK

A. Section 40 05 00 – Pipe and Fittings

B. Section 33 13 00 – Disinfection of Water System

C. Section 40 05 23 – Valves and Apputenances

D. Section 40 20 10 – Pipe Supports

E. Section 40 24 68 – Secondary Containment Piping

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.

B. Submit materials description for pipe and fittings with ASTM reference and grade and manufacturer's certification of compliance with referenced standards.

C. Submit wall thickness and pressure rating of pipe and fittings.

PART 2 PRODUCTS

2.1 PVC PIPE

A. The material used in the manufacture of the pipe shall be domestically produced rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, trade name designation H707 PVC. This compound shall be gray in color as specified, and shall be approved by ANSI/NSF International for use with potable water (NSF Std 61).

B. PVC pipe shall be manufactured in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. Each production run of pipe

manufactured in compliance to this standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. All PVC Schedule 80 pipe must also meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid PVC pipe for pressure applications, and shall bear the mark of these Listing agencies. This pipe shall have a flame spread rating of 0-25 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.

C. Product marking shall meet the requirements of ASTM D1785 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM D1785; the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture.

2.2 CPVC PIPE

A. The material used in the manufacture of the pipe shall be a rigid chlorinated polyvinyl chloride (CPVC) compound, Type IV Grade I, with a Cell Classification of 23447 as defined in ASTM D1784. This compound shall be light gray in color, and shall be approved by NSF for use with potable water. Material used shall be domestically produced CPVC material as provided by Noveon, Inc. (formerly the BFGoodrich Company), or approved equal.

B. CPVC Schedule 40 and Schedule 80 pipe shall be manufactured in accordance to the requirements of ASTM F441 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM F441. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements, and the minimum socket length for pressure-type sockets, as defined in ASTM D2672.

C. Product marking shall meet the requirements of ASTM F441 and shall include: the manufacturers name (or the manufacturers trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM F441; and the independent laboratory's seal of approval for potable water usage. Marking shall also include the flame spread rating and smoke development rating when tested and listed for surface burning characteristics per CAN/ULC S102.2 (Flame Spread (F.S.) of <25 and Smoke Development (S.D.) of <50).

2.3 FITTINGS

A. PVC fittings shall be schedule 80 grey, socket-type fabricated of ASTM D1784, Type I, Grade 1 conforming to ASTM D2467.

B. CPVC fittings shall be schedule 80 grey, socket-type fabricated of ASTM D1784, Type IV, Grade 1 conforming to ASTM F439.

2.4 JOINTS

A. All joints shall be solvent welded or union unless flanged connections are required for adjacent equipment.

B. All solvent cements used for PVC, except for pipes carrying sodium hypochlorite and sodium hydroxide shall conform to ASTM D2564 and be listed by ANSI/NSF for potable use applications.

C. All solvent cements used for CPVC, except for pipes carrying sodium hypochlorite and sodium hydroxide shall conform to ASTM F493 and be listed by ANSI/NSF for potable use applications.

D. Solvent cement for pipes carrying sodium hypochlorite or sodium hydroxide shall conform to ASTM F493 and be specially formulated for use with corrosive chemicals. Solvent shall be IPS Weld-On 724 or equal.

E. Unions shall be Schedule 80, shall conform to the materials specifications for fittings, shall be socket joint, and shall utilize EPDM or Viton O-rings compatible with the chemical service.

PART 3 EXECUTION

3.1 DELIVERY AND STORAGE OF PIPE

A. Do not store pipe where exposed to direct sunlight or heat.

B. Support the pipe uniformly.

C. Do not install pipe that is gouged or scratched forming a clear depression.

3.2 SOLVENT CEMENTING

A. Ensure that the pipe and fittings are at the same temperature prior to joining.

B. Cut pipe ends square, remove all burrs, and slightly chamfer outside edge of pipe ends.

C. Remove all dirt and moisture from the surfaces being joined.

D. Measure the socket depth and mark distance on the pipe being inserted. Check the dry fit of the components prior to applying cement.

E. Apply primer to both the pipe and fitting following the primer manufacturer's instructions.

F. Apply solvent cement appropriate for the pipe material and service following the manufacturer's instructions.

G. Allow the joint to set and cure following the cement manufacturer's instructions. Do not load the joint for at least 8 hours after joint assembly.

3.3 INSTALLING UNIONS

A. Install unions at the following locations whether shown on the plans or not:

1. Changes in direction

2. Next to all valves and other equipment

3. Every 10 feet on above grade straight pipe runs.

4. Where shown on the drawings.

3.4 INSTALLING BURIED PIPE

A. Follow standard ASTM D2774 installation practice.

B. Snake the pipe in the trench per the pipe manufacturer's recommendations to account for thermal contraction and expansion.

C. Support the pipe continuously on a smooth surface void of any stones or sharp objects.

3.5 PAINTING AND COATING

A. PVC pipe is susceptible to degradation if left exposed to direct sunlight.Coat pipe exposed to direct sunlight per Section 09 90 00.

3.6 DISINFECTION

A. Disinfect pipe used in potable water applications in accordance with Section 33 13 00.

END SECTION

SECTION 40 24 68

PVC SECONDARY CONTAINMENT PIPING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, installation, and testing of PVC secondary containment piping.

1.2 RELATED WORK

A. Section 40 05 00 – Piping and Fittings

B. Section 33 13 00 – Disinfection of Water System

C. Section 40 05 23 – Valves and Appurtenances

D. Section 40 20 10 – Pipe Supports

E. Section 40 20 90 – PVC and CPVC Process and Chemical Piping

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Submit materials description for pipe, fittings, and other appurtenances with ASTM reference and grade and manufacturer's certification of compliance with referenced standards.

C. Submit wall thickness and pressure rating of pipe and fittings.

D. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 SECONDARY CONTAINMENT SYSTEM

A. Furnish a complete double-containment piping system including piping, fittings, anchors, terminations, access tees, carrier pipe supports and associated pipe joining method.).

B. The system design shall meet the requirements of ASME/ANSI B31.3 for design criteria where temperature and pressure fall within the limits of that code.

C. System shall provide the ability to incorporate leak detection. Access tees, pull ropes, and low-point instrumentation taps shall be provided as specified by the leak detection vendor and/or contract drawings. Supplier of Piping System shall specify Pipe Sizes to accommodate leak detection cable if utilized.

2.2 MANUFACTURER'S

A. Secondary containment piping system shall be manufactured by Asahi/America, Spears Manufacturing, or equal.

2.3 DEFINITIONS

A. Product Pipe: Inside Pipe/Carrier Pipe

B. Containment Pipe: Outside Pipe

2.4 MATERIALS

A. Product and containment pipe shall be PVC per the material, dimensional, and pressure rating requirements of Section 40 20 90.

B. Any special fittings, not supplied as part of the normal product offering, shall be classified as unlisted components. Products falling into this category shall only be supplied by the manufacturer of the double containment System.

2.5 VALVES

A. Valve arrangements that are to be double contained shall be supplied pre-assembled and tested to 150% of the maximum operating pressures. Actuators, stem extensions, and other accessories shall be part of a pre-assembled package.

2.6 PIPE SUPPORTS

A. Centralizer supports, guides, etc. for product pipe shall be provided of same resin as product pipe. Supports shall be placed in a manner that a maximum of 0.1-inch deflection is allowed between supports. Supports shall allow axial movement of product pipe within containment pipe. Supports shall maintain a concentric relationship between product pipe and containment pipe. Supports shall be designed to allow the pulling of Leak Detection Cable through the pipe.

B. Anchors shall be provided of same resin as product pipe and containment pipe. Anchors shall be of same wall thickness as product and containment pipe, and must be of unitary construction. Anchors shall be fully pressure rated.

C. Support disks used to centralize fittings shall lock the product (carrier) fitting to the containment fitting. Free-floating fittings are not allowed. Support disks shall be designed to allow for flow and access cable in the annular space.

2.7 ACCESS TEES

A. Access tees shall be provided per drawings and per leak detection manufacturer's requirements. Access tees shall be of same resin as pipe.

PART 3 EXECUTION

3.1 DELIVERY AND STORAGE OF PIPE

A. Do not store pipe where exposed to direct sunlight or heat.

B. Support the pipe uniformly.

C. Do not install pipe that is gouged or scratched forming a clear depression.

3.2 INSTALLATION

A. Install piping system per manufacturer's recommended procedures.

B. Install continuous running pull rope for installation of leak detection cable if required for leak detection system.

3.3 SOLVENT CEMENTING

A. Ensure that the pipe and fittings are at the same temperature prior to joining.

B. Cut pipe ends square, remove all burrs, and slightly chamfer outside edge of pipe ends.

C. Remove all dirt and moisture from the surfaces being joined.

D. Measure the socket depth and mark distance on the pipe being inserted. Check the dry fit of the components prior to applying cement.

E. Apply primer to both the pipe and fitting following the primer manufacturer's instructions.

F. Apply solvent cement appropriate for the pipe material and service following the manufacturer's instructions.

G. Allow the joint to set and cure following the cement manufacturer's instructions. Do not load the joint for at least 8 hours after joint assembly.

3.4 INSTALLING BURIED PIPE

A. Follow standard ASTM D2774 installation practice.

B. Snake the pipe in the trench per the pipe manufacturer's recommendations to account for thermal contraction and expansion.

C. Support the pipe continuously on a smooth surface void of any stones or sharp objects.

3.5 FIELD HYDROSTATIC TESTING

A. Test containment pipe using one of the following two procedures:

1. Test containment pipe hydrostatically per Section 40 05 15. The product pipe must be pressurized to the same pressure as the containment pipe to prevent collapsing of the product pipe.

2. To avoid moisture in the containment space, an air test can be conducted on the containment pipe using air at 5 psi. The inner carrier pipe shall be full of water and under pressure to avoid any possible collapse. When testing with air, the ambient temperature should be above 40º F and extra safety precautions for personnel shall be put in place during the test.

3.6 DISINFECTION

A. Disinfect pipe used in potable water applications in accordance with Section 33 13 00.

END SECTION

SECTION 40 50 00

INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 –– GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall procure the services of a single Process Control System Supplier (PCSS) and a single Pressure Filter System Supplier (PFSS) to furnish and install all materials, equipment, labor and services, except for those services and materials specifically noted, required to achieve a fully integrated and operational system as specified herein and in other Specification Sections listed below.

B. Requirements specified in this Section apply to all equipment specified in the above sections, unless otherwise specified. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections:

1. 26 24 19 Motor Control Centers
2. 40 50 01 Testing
3. 40 51 20 PLC Hardware and Software
4. 40 51 30 Human Machine Interface (HMI)
5. 40 51 50 Control Panels and Panel Mounted Equipment
6. 40 92 32 Control Loop Descriptions

C. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

D. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted. In order to confirm compatibility between all equipment, coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.

E. Equipment shall be fabricated, assembled, installed and placed in operating condition in full conformity with the project Specifications, Drawings, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer.

F. To facilitate the Owner's future operation and maintenance, similar products (e.g., differential pressure transmitters, SCADA I/O cards) shall be supplied from the same manufacturer.

G. All equipment and installations shall satisfy applicable Federal, State and local codes.

H. Use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify said numbering scheme without the Engineer's approval.

I. The work of this project includes, but is not necessarily limited to the following:

1.02 RELATED WORK

A. Process Flow Diagrams (PFD) are included in the Drawings.

B. Control System Architecture Block Diagram is included in the Drawings.

C. Specific control system and instrumentation materials and requirements are included in related Sections of Division 40.

D. Instrumentation and Controls conduit systems are specified in Section 26 05 33.

1.03 SUBMITTALS

A. General submittal requirements include:

1. Refer to Division 1 for general submittal requirements.
2. Other Division 40 Sections may have additional submittal requirements.
3. Shop drawings shall be submitted as detailed herein. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.
4. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.
5. Submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5 inch by 11 inch for inclusion within the binder. Maximum binder size shall be 3 inches.
6. The submittal drawings' title block shall include, as a minimum, the PCSS registered business name and address, Owner and project name, drawing name, revision level, and personnel responsible for the content of the drawing.
7. Incomplete or partial submittals not complying with the submittal arrangements outlined in this Section will be returned without review.
8. Separate submittals shall be made as follows:
    a. Project Plan, Deviation List and Schedule Submittal
    b. Application Development System Submittal
    c. Coordination Meetings Agenda
    d. I/O List Submittal
    e. Field Instrument Submittal
    f. Hardware Submittal and Software Packages Submittal
    g. Panel Layout Drawings and Wiring Diagram Submittal
    h. Testing Plans Submittal
    i. Training Plan Submittal

1) Preliminary Training Plan Submittal
2) Final Training Plan Submittal

j. Spares, Expendables, and Test Equipment Submittal

k. Final System Documentation

B. Project Plan, Deviation List, and Schedule Submittal

1. Submit a Project Plan within 21 calendar days from Notice to Proceed date. The Project Plan shall, as a minimum, contain the following:

a. Overview of the proposed control system in clear text format describing the PCSS understanding of the project work, preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination.

b. Approach to work in clearly written format describing how the PCSS intends to execute the work. A discussion of switchover, startup, replacement of existing equipment with new, and other tasks as required by these specifications shall be included as applicable.

c. Preliminary HMI software, PLC software, and PLC hardware submittal information, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.

d. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each key individual and specify in writing their commitment to this project.

e. Preliminary coordination meeting agendas as specified herein.

f. Preliminary testing plan

g. Preliminary training plan

h. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, I/O wiring diagrams, and graphical display presentations.

2. Exceptions to the Specifications or Drawings shall be clearly defined in a separate Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an "or equal' or "exception" to the specifications shall be at the sole discretion of the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. Project schedule shall be prepared and submitted using Primavera, Microsoft Project, or equal scheduling software. Schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation,

testing, and start-up milestones in that schedule. The project schedule shall illustrate all major project milestones including the following:

a. All subsequent project submittals shall be scheduled. Include in the time allotment; the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.

b. Proposed dates for all project coordination meetings.

c. Hardware purchasing, fabrication, and assembly (following approval of related submittals)

d. Software purchasing and configuration (following approval of related submittals)

e. Shipment of all instrument and control system equipment

f. Installation of all instrument and control system equipment

g. Testing: Schedule for all testing. Testing schedule shall include submittal of test procedures a minimum of 30 days prior to commencement of testing. Schedule shall also include submittal of completed test procedure forms for review and approval by the Engineer prior to shipment, startup, or subsequent project work.

h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.

i. Schedule for all training; including submittal and approval of O&M manuals, factory training, and site training.

C. Coordination Meetings Agenda:

1. Agendas shall be submitted for the Coordination Meetings as specified herein. Submit proposed Control System Coordination Meeting Agenda a minimum of two weeks prior to the scheduled meeting date for review and comment by the Engineer.

D. Input/Output (I/O) Address List Submittal

1. Submit a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.

2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included within these specifications), and requirements outlined in the Specifications.

3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format on a CD-ROM and an 8-1/2 inch by 11-inch hard copy.

4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O.

5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet tables shall include the following information:

a. TAG NUMBER(S): The identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.

b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.

c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.

d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.

e. LOGICAL POINT ADDRESS: If the PCSS is performing the PLC programming, I/O address of each point. If the PCSS is not performing the PLC programming, then leave this field blank for use by the PFSS.

f. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO – Pulse Output.

g. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."

h. ENGINEERING UNITS: The engineering units associated with the Analog I/O.

i. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.

6. The I/O list shall be sorted in order by:

   a. Physical location

   b. I/O Type

   c. Loop Number

   d. Device Tag

7. After the I/O list is approved, do not modify the PLC I/O addresses without approval by the Engineer.

8. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single I/O module will not disable all mechanical components of the redundant system. This applies to all I/O types.

E. Field Instruments Submittal

1. Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment ordered by the loop numbering system as shown in the Contract Documents.

2. Submit separate data sheets for each instrument including:

   a. Plant Equipment Number and ISA tag number per the drawings

   b. Product (item) name used herein and on the Contract Drawings

   c. Manufacturer's complete model number

   d. Location of the device

   e. Input / output characteristics

   f. Range, size, and graduations in engineering units.

   g. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with the requirements of the Contract Documents.

h. Materials of construction for enclosure and wetted parts.

i. Instrument or control device sizing calculations where applicable.

j. Certified calibration data for all flow metering devices.

k. Two-wire or four-wire device type as applicable.

3. Submit index and data sheets in electronic format as well as hard copies on 8-1/2 by 11 inches formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.

F. Hardware Submittal and Software Packages Submittal

1. For each hardware component indicated below, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA S20, general data sheet; however, other formats will be acceptable provided they contain all required information.

2. Catalog cuts for supplied Programmable Logic Controller (PLC), process controller equipment, remote telemetry units (RTU), including central processing units, redundancy units, memory, input modules, output modules, modems, network interface modules, mounting racks, and power supplies. Submit descriptive literature for each hardware component that fully describes the units being provided. Any deviation of the hardware systems from the preliminary hardware submittal included in the Process Plan or Applications Development System submittal shall be described in detail.

3. Catalog cuts for HMI servers, HMI workstations, historian servers, memory, printers, mass storage devices, modems, peripherals, power supplies, networking and all other hardware being provided. Submit descriptive literature for each hardware component, which fully describes the units being provided.

4. Complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, and like equipment. The system architecture shall be complete and shall depict all required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pin- outs, port numbers, and rack slot numbers. The intent of this specification requirement is for the PCSS to develop a diagram that is complete in every aspect to allow purchase of all required equipment by part number, and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Minimum sheet size shall be 11"x17" and using a larger sheet size or more than one sheet is acceptable.

5. Submit details of the controller development software package, the local operator graphic panel development software package, and the HMI software application packages to be used for each piece of equipment. Indicate all standard and optional features provided. Confirm in the submittal that the licenses will be assigned to the Owner at the time of purchase. Any deviation of the software platforms from the preliminary software submittal included in the Project Plan shall be described in detail.

G. Panel Layout Drawings and Wiring Diagrams Submittal

1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, the Contractor shall provide to the PCSS the approved shop drawings and submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings will be included in the Final Documentation submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.
2. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" minimum in size. As a minimum, the panel drawings shall include the following:
    a. Interior and exterior panel elevation drawings to scale.
    b. Nameplate schedule.
    c. Conduit access locations.
    d. Panel construction details.
    e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
    f. Fabrication and painting specifications including color (or color samples).
    g. Submit construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
    h. Heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
    i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor and included in the Project Bid Price.
3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall

be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" minimum in size.

4. ISA Loop Wiring Diagrams: Detailed ISA loop wiring diagrams showing requirements for each loop which is shown on the contract drawings. The Loop Drawings shall be prepared in accordance with ISA Standard S5.4 latest edition with the layout following Figures 5 and 6 (shown in the S5.4 Standard), titled Minimum Required Items Plus Optional items". Loop drawings shall be 11"x17" minimum in size. The information required on the Loop Drawings in order to satisfy the "minimum" and "optional" requirements is as follows:

    a. Minimum Required Items – The following information shall be provided on Loop Drawings in order to meet this requirement:

        1) Identification of the loop and loop components shown on the P&IDs. Other principal components of the loop to be shown and identified under ISA-5.1, "Instrumentation Symbols and Identification".

        2) Word description of loop functions within the title. If not adequate, use a supplemental note. Identify any special features or functions of shutdown and safety circuits.

        3) Indication of the interrelation to other instrumentation loops, including overrides, interlocks, cascaded set points, shutdowns and safety circuits.

        4) All point-to-point interconnections with identifying numbers or colors of electrical cables, conductors, pneumatic multitubes, and individual pneumatic and hydraulic tubing. This identification of interconnections includes junction boxes, terminals, bulkheads, ports, and grounding connections.

        5) General location of devices such as field, panel, auxiliary equipment, rack, termination cabinet, cable spreading room, I/O cabinet, etc.

        6) Energy sources of devices, such as electrical power, air supply, and hydraulic fluid supply. Identify voltage, pressure, and other applicable requirements. For electrical sources, identify circuit or disconnect numbers.

        7) Process lines and equipment sufficient to describe the process side of the loop and provide clarity of control action. Include what is being measured and what is being controlled.

        8) Actions or fail-safe positions (electronic, pneumatic, or both) of control devices such as controllers, switches, control valves, solenoid valves, and transmitters (if reverse- acting). These are to be identified in accordance with ISA-5.1, "Instrumentation Symbols and Identification".

    b. Additional Required Items – The following information shall be provided on Loop Drawings (in a tabular format as shown in Figures 5 and 6 of ISA 5.4) in order to meet this requirement:

        1) Process equipment, lines, and their identification numbers, source, designation, or flow direction.

        2) Reference to supplementary records and drawings, such as installation details, P&IDs, location drawings, wiring diagrams or drawings, and instrument specifications.

3) Specific location of each device, such as elevation, area, panel subdivision, rack or cabinet number and location, I/O location.

4) Cross reference between loops that share a common discrete component, such as multipen recorders, dual indicators, etc.

5) References to equipment descriptions, manufacturers, model numbers, hardware types, specifications or data sheets, purchase order numbers.

6) Signal ranges and calibration information, including setpoint values for switches, and alarm and shutdown devices.

7) Software reference numbers, such as I/O addresses, control block types and names, network interfaces, point names.

8) Engraving or legend information that helps identify the instrument or accessory. Per ISA-5.4-1991 11.

9) Accessories tagged or otherwise identified, such as regulators, filters, purge meters, manifold valves, root valves.

10) References to manufacturer's documentation such as schematics, connection details, operating instructions.

11) Color code identification for conductors or tubes that use numbers for differentiation.

H. Testing Plan Submittals

1. Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop with sign-off areas for the PCSS, Engineer, and Owner. Refer to Section 40 50 01 for specific testing requirements and submit separate procedures for each specified test phase.

2. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

3. Each loop shall have a Loop Status signoff form to organize and track its inspection, adjustment and calibration. These forms shall include the following information and check-off items:

   a. Project Name.

   b. Loop Number.

   c. Detailed test procedure indicating exactly how the loop will be tested including all required test equipment, necessary terminal block numbers, and simulation techniques required.

   d. Tag Number for each component.

   e. Checkoffs/signoffs for each component.

1) Tag/identification
2) Installation
3) Termination - wiring
4) Termination - tubing
5) Calibration/adjustment

f. Checkoffs/signoffs for the loop.
1) Panel interface terminations
2) I/O interface terminations
3) I/O signal operation
4) Inputs/outputs operational: received/sent, processed, adjusted
5) Total loop operation
6) Space for comments.
7) Sign off and date fields for the Contractor, the Engineer, and the PCSS.

4. Each active analog subsystem element shall have a Component Calibration form. These forms shall have the following information including space for data entry:
a. Project Name.
b. Loop Number.
c. ISA Tag Number and I/O Module Address.
d. Manufacturer.
e. Model Number/Serial Number.
f. Summary of Functional Requirements. For example:
1) For Indicators: Scale ranges
2) For Transmitters/Converters: Scale and chart ranges
3) For Computing Elements: Function
4) For Controllers: Action (direct/reverse) control modes (PID)
5) For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
6) For I/O Modules: Input or output
g. Calibrations; for example:
1) For Analog Devices: Required and actual inputs and outputs at 0, 50 and 100 percent of span.
2) For Discrete Devices: Required and actual trip points and reset points.
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Required and actual inputs or outputs for 0, 50 and 100 percent of span.

h. Space for comments.

i. Sign off and date fields for the Contractor, the Engineer, and the PCSS.

I. Spares, Expendables, and Test Equipment Lists Submittal

1. This submittal shall include for each Subsystem:

a. A list of, and descriptive literature for, spares, expendables, and test equipment as specified in Division 40.

b. A list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.

c. Unit and total costs for the additional spare items specified or recommended for each subsystem.

J. Final System Documentation

1. The Final System Documentation shall consist of operations and maintenance manuals as specified herein. The manuals shall be bound in three-ring binders, maximum size of three inches, with Drawings reduced to 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion. Each section shall have a uniquely numbered tab divider, and each component within each section shall have a separate binder tab divider.

2. The operations and maintenance manuals shall, at a minimum, contain the following information:

a. Table of Contents

1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.

b. Instrument and Equipment Lists

1) The following lists shall be developed in Excel and provided not only as a hardcopy in O&M but also electronically on a CD.

2) An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

3) An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Data Sheets with Vendor Operations and Maintenance Information

1) ISA S20 data sheets shall be provided for all field instruments.

2) Cover page for each device, piece of equipment, and OEM software that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is

ISA S20, general data sheet; however, other formats will be acceptable provided they contain all required information.

3) Final vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.

4) For any component requiring dip switch settings or custom software configuration, that information shall be included along with the corresponding data sheets and O&M information.

d. As-Built Drawings

1) Complete as-built drawings, including all drawings and diagram specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system in connected to, including terminal points of equipment not supplied by the PCSS.

2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

e. Original Licensed Software

1) Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.

f. Electronic O&M Information

1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.

2) Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.

3) Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.

4) Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.

5) If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format and shall be a minimum of 800 by 600 pixels and shall include sound.

3. The cover and edge of each volume shall contain the following information:
    a. Project Name (refer to Contract Documents)
    b. Contract Number (refer to Contract Documents)
    c. Instrumentation and Control System Hardware [or Applications Engineering] Operations and Maintenance Manual
    d. Specification Sections [List appropriate section]
    e. Subcontractor Name
    f. Date
    g. Volume X of Y [Where X is the volume number and Y is the number of volumes]

1.04 COORDINATION MEETINGS

A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the PFSS's Project Engineer, if applicable. Other Division 40 specifications may require additional meetings.
    1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan and Schedule Submittal. The purpose of the meeting shall be to discuss the PCSS's Project Plan and Schedule Submittal, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. The meeting will last up to one (1) business day.
    2. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS and PFSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and PFSS Supplier. The meeting will last up to one (1) business day.
    3. Regular on-site meetings for during time PCSS staff is at the plant sites.

1.05 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (formerly the Instrumentation, Systems and Automation Society) (ISA)
    1. ISA S5.2 Binary Logic Diagrams for Process Operations
    2. ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
    3. ISA S5.4, Instrument Loop Diagrams

4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
5. ISA RP60.3, Human Engineering for Control Centers
6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers

C. National Electrical Manufacturers Association (NEMA)

D. National Fire Protection Agency (NFPA)

1. NFPA 70, National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL)

1. UL 508 – Industrial Control Equipment

F. American Society for Testing and Materials (ASTM)

1. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.

1.06 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. The Company shall be a member of Control System Integrators Association Certified (CSIA) and key personnel shall hold ISA CCST Level 1 certification, or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
3. Has been actively engaged in motor control centers, industrials control panels, and system integration for the type of work specified in this Specification Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 250 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

E. Only approved suppliers will be accepted. The Contractor must name the proposed system supplier per Division 0.

F. The listed approved PCSS's shall not be required to submit a qualification proposal. Suppliers interested in being listed as an equal shall submit three copies of a qualification proposal to the ENGINEER no later than 21 days before the bid opening date. A list of approved equals shall be issued no later than 13 days before the bid opening date.

1. The qualification proposal shall provide details and a description of how the supplier proposes to fulfill the requirements set forth in these specifications. The PCSS shall present the proposal in sufficient detail so that proper evaluation regarding the experience and capabilities of the supplier can be performed.

a. The proposal shall contain evidence that the PCSS has sufficient financial resources to meet the obligations incidental to the performance of the work including available bonding. (This requirement may be provided in the form of a verifiable or certified financial report for the company's latest fiscal year.)

b. The proposal shall contain a list of personnel available for assignment to the responsible positions of Project Manager, Project Engineer, Installation Supervisor, and Area Service Representative. Also, include a concise resume of each individual's education, work experience, and accomplishments.

c. The proposal shall contain the following specific information:

1) Maintenance services available for hardware and software: Evaluation shall be based on the PCSS's capability to provide the required routine and emergency services. The PCSS's proposal is to describe the capabilities and location of his/her nearest (to jobsite) service organization. The intent of the specifications is to obtain all system maintenance services from the PCSS. If the PCSS intends to subcontract all or portions of the service requirements, it must be stated as such along with the name and address of the organization.

2) Technical validation, examples of recently completed and similar scope projects: The PCSS shall provide information regarding type, size, complexity, and performance of five systems recently completed, along with names, addresses, and telephone numbers of persons qualified to verify PCSS's statements approximate cost of the instrumentation system supplied, project completion date and description. Evaluation shall be based on the similarity of system requirements and supplier's performance.

3) A description of how the supplier plans to execute the various functions and locations where the various portions of the work shall be performed, coordinated and managed (e.g., design, engineering, manufacturing, programming, testing and scheduling). The PCSS is required to state in his/her proposal those functions which he/she intends to subcontract to other organizations and include the name, address and capabilities of these organizations.

4) The PCSS shall be required to demonstrate a minimum of five years' past control systems of comparable size, type and complexity to the proposed project. The

PCSS shall be required to have his/her own in-house capability to handle complete system engineering, fabrication, and testing.

5) The PCSS shall indicate that he/she has in his/her employment capable personnel for detailed engineering, coordination, drafting, procurement and expediting, scheduling, construction, testing, inspection, installation, training start up service for calibration and commissioning and warranty compliance for the period specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Division 1.

B. Shipping Precautions

1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.

2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.

4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the owner.

1.08 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags

1. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section. Equipment shall be tagged before shipping to the site.

2. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

3. All supplied field instrument transmitters and field instrument transmitter elements shall have a stainless-steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless-steel wire (24 gauge inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

B. Panel Nameplates

1. See Section 40 51 50.

1.09 WARRANTY

A. Provide warranty per Section 00 65 36, Warranties and Bonds, and as specified herein.

1.10 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Refer to Section 26 05 00 and the Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Equipment shall be designed to operate at the project ground elevation.

C. Temperature:

1. Outdoor areas' equipment shall operate [between - 30 to 50 C degrees ambient].

2. Equipment located in indoor locations shall operate between [10 to 35 C] degrees ambient minimum.

3. Storage temperatures shall range from [0 to 50 C] degrees ambient minimum.

4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.

D. Relative Humidity: Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 0 to 100 percent relative, condensing humidity.

PART 2 -PRODUCTS

2.01 PRODUCTS GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Division 26. Provide and size anchors in accordance with Division 1 and 5 as required per the seismic calculations. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical

1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).

3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.

4. All switches shall have double-pole double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.

5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired fail-safe to the SCADA system. A fail-safe condition is an open circuit when in an alarm state.

6. Materials and equipment shall be UL approved. Where components are not available with UL approval, integrate the device with ground fault protective devices, isolation transformers, fuses, or other protective equipment necessary to achieve compliance with UL 508 requirements.

7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

8. All transmitter output signals shall include signal and power source isolation.

2.02 ELECTRICAL SURGE PROTECTION

A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 26 05 00.

B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate enclosure, unless conduit mounted, and shall be Phoenix Contact PT

Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel BP1-24, or equal.

C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, or equal.

D. Non-Fiber Based Data Highway or Communications Circuits – Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, or equal.

E. Inductive Loads – At a minimum, provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

F. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.03 TUBING AND FITTINGS

A. All instrument air header takeoffs and branch connections less than 2-in shall be 316 stainless steel.

B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. The materials for fittings and valves shall be compatible with process fluids. Where metallic fittings and valves are compatible, wetted materials shall be Type 316 stainless steel.

C. The materials for instrument tubing shall be compatible with process fluids. Where metallic tubing is compatible, tubing shall be fully annealed ASTM A269 Seamless 316 grade free of OD scratches having the following dimensional characteristics as required to fit the specific installation:

1. 1/4-in to 1/2-in O.D. by 0.035 wall thickness
2. 5/8-in to 1-in O.D. by 0.049 wall thickness
3. 1-in O.D. by 0.065 wall thickness
4. 1-1/4-in O.D. by 0.065 wall thickness
5. 1-1/2-in O.D. by 0.083 wall thickness
6. 2-in O.D. by 0.095 wall thickness

D. All process connections to instruments shall be annealed 1/2-inches O.D. stainless steel tubing, Type 316.

E. All tube tracks shall be supported by stainless steel and installed as per manufacturer's installation instructions.

2.04 SPARE PARTS

A. Spare parts of the type and quantity as recommended by the manufacturer shall be furnished for all devices furnished under these sections.

B. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Engineer.

C. As a minimum, furnish the following spare parts for control panels:

1. Timers - Five of each type installed
2. Relays - Five of each type installed
3. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed
4. Light bulbs - 10% (minimum of 10) of each type installed
5. Power supplies - one of each type installed.
6. Manufacturer's cables - one of each type installed.
7. Selector switches/pushbuttons - Two of each type installed including 5 contact blocks.
8. Surge protection devices - One of each type installed.
9. Provide one quart of touch-up paint, for each type and color used for all RTU cabinets, panels, and consoles supplied.

D. The following field Instrument related Spare Parts shall be furnished:

1. Miscellaneous: One-year supply of items recommended by the manufacturer of the equipment including all reagents, dissolved oxygen probes, batteries, and calibration standards as needed to operate and maintain the furnished equipment.

E. PLC components

1. One spare CPU of each type supplied for each plant
2. Two spare I/O modules of each type supplied for each plant
3. One spare specialty interface module of each type supplied for each plant
4. One spare power supply of each type supplied for each plant

PART 3 -EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of any interference with other work, proceed as directed by the Contractor and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

B. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required for the locations as shown on the Drawings and specified in Division 26. All work shall be in strict accordance with codes and local rulings.

C. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

D. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained. Process tubing shall be installed rigidly with supports to prevent significant vibrations.

E. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed as shown and not interfere with any other equipment.

F. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

G. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with his/her equipment is installed in accordance with best industry practice. Schedule and coordinate work under this section with that of the electrical work specified under applicable Sections of Division 26.

H. Installation of fiber optic cable within control panel and console assemblies. Refer to cable manufacturer's specifications for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief as required to meet manufacturer's strain requirements.

I. Provide local electrical shutoffs and disconnects for all 4-wire field instruments requiring 120 VAC power. Electrical disconnects shall be suitably rated disconnect switches or manual motor starters as specified under Division 26.

J. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare on LED, LCD, or other digital readouts.

K. Loop Tuning - All electronic control stations incorporating PID controllers shall be tuned following field installation and calibration of instrumentation and control system components, but prior to commencement of the specified field tests. Field testing will be immediately ‘failed’ if loop tuning for the entire installed system is not complete.

   1. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning

method. Assigning common PID factors for identical loops following field tuning of a single typical loop is acceptable. However, tuning documentation shall be submitted for each loop individually as specified in Part 1 of these Specifications.

2. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control of field mounted, dedicated PID controllers or software based PID controllers residing as part of the programmable logic controller system. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.
3. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve 1/4 amplitude damping or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
4. Loop performance and stability shall be verified in the field following tuning by step changes to setpoint. Submit loop tuning methodology and verification as part of the final system documentation as specified in Part 1.
5. For cascade loops, tune both sets of controllers so that the cascade loop achieves the loop tuning characteristics specified herein.

3.02 TESTING

A. Refer to Section 40 50 01.

END OF SECTION

SECTION 40 50 01

I&C – TESTING

PART 1 –– GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and installed. Complete as shown on the Drawings and as specified herein.

B. This section covers the testing requirements for all devices and systems furnished and installed detailed on the Drawings and in the Loop Diagrams, and as described in the related Sections of Division 40.

C. Refer to Section 40 50 00.

1.02 RELATED WORK

A. Refer to Section 40 50 00.

1.03 SUBMITTALS

A. Refer to Section 40 50 00.

1.04 REFERENCE STANDARDS

A. Refer to Section 40 50 00.

1.05 QUALITY ASSURANCE

A. Refer to Section 40 50 00.

1.06 SYSTEM DESCRIPTION

A. N/A

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 40 50 00.

1.08 PROJECT/SITE REQUIREMENTS

A. Refer to Section 40 50 00.

1.09 MAINTENANCE

A. Refer to Section 40 50 00.

1.10 WARRANTY

A. Refer to Section 40 50 00.

1.11 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 40 50 00.

1.12 COORDINATION MEETINGS

A. Refer to Section 40 50 00.

PART 2 -PRODUCTS

2.01 NOT USED

PART 3 -EXECUTION

3.01 TESTING - GENERAL

A. See execution requirements in Section 40 50 00.

B. As part of the requirement of this specification section, it is the responsibility of the PCSS to provide a complete operational control system for Well 1 and Well 3. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section. The PCSS shall test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the PCSS shall be tested at the factory as a single fully integrated system.

C. The PCSS shall test the system so that the Owner and Engineer can verify all the points in the existing control system. The PCSS shall coordinate testing of the ORT and FDT with the Owner.

D. At a minimum, the testing shall include the following:

1. Unwitnessed Factory Test (UFT).
2. System Integration Test (SIT).
3. Operational Readiness Test (ORT).
4. Functional Demonstration Test (FDT).
5. 30-day Site Acceptance Test (SAT).

E. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

F. All tests shall be conducted in accordance with prior Engineer and/or Owner-approved procedures, forms, and all checklists as submitted by the PCSS under Specification 40 50 00 Part 1.03. Each test to be performed shall be described and a space provided after it for sign-off by the appropriate parties after its satisfactory completion. The PCSS shall include “punchlist” forms with the test procedures to document issues that arise during the testing. Punchlist forms, at a minimum, shall include a specification cross reference; an issues description field; a resolution description field; and a sign-off area for the PCSS, Owner, and Engineer.

G. Copies of the signed-off test procedures, forms, and checklists will constitute the required testing documentation. The test result forms shall be submitted to the Engineer for approval within 10 days of completion of each test.

H. The PCSS shall provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical

to test with real process variables, equipment, and data, provide suitable means of simulation. These simulation techniques shall be defined in the test procedures.

I. The PCSS shall coordinate all required testing with the Contractor, all affected Subcontractors, the Engineer, and the Owner.

J. The PCSS shall furnish the services of field service engineers, all special calibration and test equipment, and labor to perform the field tests.

K. The Engineer reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the specified requirements shall be performed at no additional cost to the Owner. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

L. No equipment shall be shipped until the Engineer and/or Owner has received all test results and approved the system is ready for shipment.

M. Correction of Deficiencies

1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.

2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Prior to shipment of the equipment, the entire system, except primary elements, final control elements, and field-mounted transmitters, shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/functions.

B. All panels, consoles, and assemblies shall be inspected and tested to verify their conformance with related submittals, Specifications, and Drawings.

C. During the tests, all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.

D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.

1. All panels and enclosures being provided shall undergo a thorough inspection to verify the integrity of the cabinet enclosures, frame structures, paint work and finish, etc. Additionally, the PCSS shall review the panel drawings with the Owner and/or Engineer to ensure they accurately reflect the panel layout and wiring.

2. Panel wire pull tests shall be performed on all wiring to ensure all wiring has been connected to the appropriate torque to prevent wires from coming loose.

3. For panels provided in new enclosures, heat loading tests shall be performed to ensure proper cooling/ventilation is being provided.

4. UPSs shall be tested with all equipment connected to verify the UPSs have been sized correctly to maintain the specified run time.

5. An I/O point checkout of at least 50 percent of each I/O module shall be performed to verify proper operation of the input/output points. To perform this test, the PCSS shall obtain copies of the PLC configuration files from the Application Engineering Services (AES) Supplier prior to proceeding with the UFT. The verification of the signals will be accomplished via the use of the PLC programming software. At a minimum, the I/O checkout shall consist of four steps.

    a. Digital input signals shall be jumpered within the termination connections of the PLC panels and verification of proper alarming, statuses, etc., shall be performed utilizing the tools available in the PLC programming software.

    b. Analog input signals shall be connected to a signal generator at the termination connections and signals shall be verified at zero percent, 25 percent, 50 percent, 75 percent, and 100 percent of full scale. The appropriate scaled value shall be verified utilizing the tools available in the PLC programming software.

    c. Digital output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.

    d. Analog output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by utilizing a digital multimeter to measure the current/voltage generated at the termination points.

E. All control panels provided or modified under the requirements of the related technical specification sections of Division 40 shall be included in these tests.

F. Upon successful completion of the UFT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and coordinate the scheduling of the SIT with the AES Supplier.

3.03 FACTORY TESTING - SYSTEM INTEGRATION TEST (SIT)

A. Before scheduling the SIT, the PCSS shall determine through his own UFT and through his internal quality assurance program that the equipment is ready for the SIT.

B. The SIT shall be conducted a minimum of three weeks before the Witnessed Factory Test. The SIT shall be a joint test by the PCSS and the AES Supplier conducted at the PCSS's facility. As part of the requirements of Section 40 50 00-1.06, the PCSS's factory testing facility shall be within 200 miles of project site. The test will be an unwitnessed test, and the PCSS shall include time within the construction schedule for this test.

C. The purpose of the SIT is to allow the PCSS and the AES Supplier to jointly verify the functionality, performance, and stability of the hardware and software as a complete integrated system. The AES Supplier will load the application software on the PLCs, SCADA servers, and historian. The entire system will then be tested. All process control strategies shall be simulated to ensure proper operation. The primary objective of the SIT is to allow the PCSS and the AES Supplier to perform a dry run of the WFT and thus verify the system's readiness to move forward with the WFT.

D. The PCSS and AES Supplier shall utilize the approved WFT Procedures as the basis for the tests to be performed during the SIT.

E. Minimum testing to be performed during the SIT shall include, but not be limited to, the following:

1. Verification of proper scanning, communication, and complete data acquisition of the entire system.
2. Verification of all redundant functionality of components.
3. Verification of proper power failure recovery.
4. Verification of proper indication for communication error issues.
5. A complete I/O point checkout shall be performed to verify proper operation of each input/output point. The I/O checkout shall consist of four steps.
    a. Digital input signals shall be jumpered within the termination connections of the PLC panels and verification of proper alarming, statuses, etc., shall be performed at the HMI.
    b. Analog input signals shall be connected to a signal generator at the termination connections and signals shall be verified at zero percent, 25 percent, 50 percent, 75 percent, and 100 percent of full scale. The appropriate scaled value shall be verified at the HMI. Simultaneously, verification of alarming shall occur. The alarming verification shall, at a minimum, include HiHi, Hi, Lo, LoLo, Rate of Change, and Alarm Deadband.
    c. Digital output signals shall be initiated by the user from the HMI system. Verification shall occur within the PLC panel by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.
    d. Analog output signals shall be initiated by the user from the HMI system. Verification shall occur in the PLC panel by utilizing a digital multimeter to measure the current/voltage generated at the termination points.
6. Upon successful completion of the SIT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the WFT as noted below.

3.04 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Following installation of the process control system components and prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, wired, calibrated, tested, etc., and documented) that it is installed and ready for the ORT as defined below.

B. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications.

C. The Loop/Component Inspections and Tests shall be implemented using Engineer-approved forms and checklists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the system supplier:

1. Project Name, Test Date, PCSS Name, and Lead PCSS Technician Name.
2. Loop Number.

3. Tag Number for each component.
4. Check-offs/sign-offs for each component: Tag/identification; installation; termination (wiring and tubing); scale, range, and setpoint as applicable; and calibration/adjustment (four-point for analog, set point for switches) rising and falling.
5. Check-offs/sign-offs for the loop: Panel interface terminations; I/O interface terminations; I/O signal operation; inputs/outputs operational (received/sent, processed, adjusted); total loop operation; process controller scaling and adjustment; and space for comments.
6. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign-off by the PCSS.
    a. Project Name.
    b. Loop Number.
    c. Component Tag Number of I/O Module Number.
    d. Component Code Number Analog System.
    e. Manufacturer (for Analog system element).
    f. Model Number/Serial Number (for Analog system).
    g. Summary of functional requirements shall include, but not be limited to, scale and chart ranges of indicators, recorders, and transmitters/converters; functions of computing elements; and parameters of controllers (i.e., proportional, integral, derivative, reverse/forward acting, etc.).
    h. Calibrations shall include testing of analog input and output signals at zero, 10, 50, and 100 percent of span. Where appropriate, discrete input signals shall include details regarding actual trip points and reset points.
    i. Space for comments.
    j. Space for sign-off by the PCSS.

D. The PCSS shall maintain the Loop Status Reports sheets at the job site and make them available to the Engineer/Owner at any time.

E. These inspections, calibrations, and tests do not require witnessing. However, the Engineer will review Loop Status Sheets and spot-check the PCSS test process periodically. Any deficiencies found shall be corrected by the PCSS prior to commencement of the Functional Acceptance Test.

F. Prior to checkout of the I/O to the HMI, the PCSS shall thoroughly test all I/O from the field device to the PLC terminals, and verify the PLC is powered up and the PLC is communicating to the SCADA servers. After the PCSS has successfully tested all I/O from the field devices to the PLC terminals, the PCSS and AES Supplier shall jointly test all I/O from the HMI to the field device. Should this test prove to be unsuccessful, the PCSS and AES Supplier shall test from the HMI to the terminations located in the Owner's termination cabinet, and the PCSS shall inform the Owner in writing of the discrepancy with the existing field wire.

G. Computer-Manual (i.e., Remote-Manual) start/stop, open/close commands of all devices controlled by the SCADA system shall be verified jointly by the PCSS and AES Supplier during the ORT. Subsequent to verification of Computer-Manual control, the PCSS may

request from the Owner and Engineer permission to begin replacement of the next PLC. Simultaneously, the AES Supplier may continue with Computer-Automatic testing to confirm the control strategies were implemented as specified.

H. For all panels with enclosures (new and existing) modified by this contract, heat load tests shall be performed to ensure proper cooling/ventilation is being provided.

I. Upon successful completion of the ORT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the FDT as noted in the following section.

3.05 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. Prior to startup and the 30-day Site Acceptance Test, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the ORT. The FDT will be a joint test by the PCSS and the AES Supplier.

B. Once a process area has been started up and is operating, a witnessed FDT shall be performed on that system to demonstrate that it is operating and is in compliance with these Specifications. A witnessed FDT shall be performed on each process area. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.

C. Loop-specific and non-loop-specific tests shall be the same as specified under WFT, except that the entire installed system shall be tested and all functions demonstrated using live field-based data to the greatest extent possible.

D. Updated versions of the documentation specified to be provided for during the factory tests shall be made available to the Engineer at the job site both before and during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site, both before and during testing.

E. The daily schedule specified to be followed during the factory tests shall also be followed during the FDT.

F. During the FDT, a demonstration of communication failure and recovery shall be accomplished. This test shall be scheduled and coordinated with Owner's personnel to minimize the impact on plant operations.

G. Following initial startup, the entire process control system shall operate for a continuous 100 hours without failure before this test will be started.

H. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the PCSS shall perform repairs, replacement, and/or retest within 10 days.

I. Upon successful completion of the FDT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the SAT as noted in the following section.

3.06 FIELD TESTING - 30-DAY SITE ACCEPTANCE TEST (SAT)

A. After completion of the Operational Readiness and Functional Demonstration Tests, the system shall undergo a 30-day Site Acceptance Test (SAT), under conditions of full plant

process operation, without a single non-field-repairable malfunction. The SAT will be a joint test by the PCSS and the AES Supplier.

B. During this test plant operations, PCSS personnel and AES Supplier personnel shall be present as required to address any potential issues that would impact the overall system operation. The PCSS is expected to provide personnel for this test who have an intimate knowledge of the hardware, software, field wiring and network configuration of the system. The AES Supplier is expected to provide personnel for this test who have an intimate knowledge of the software programming of the system. When PCSS personnel are not on-site, the PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff are available by phone and/or on-site within four hours of a request by operations staff.

C. While this test is proceeding, the Engineer and Owner's Agent shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain the responsibility of Owner and the decision of plant operators regarding plant operations shall be final.

D. Any malfunction during the tests shall be analyzed and corrections made by the AES Supplier for software programming issues, and the PCSS for hardware, software, field wiring and network configuration issues. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction during this 30 consecutive day test period which cannot be corrected by the PCSS's personnel within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction. Upon completion of repairs by the PCSS, the SAT will be re-started from the date which the PCSS successfully corrected the malfunction(s) and the Owner and Engineer have accepted and signed off on the repairs.

F. The PCSS shall perform repairs or replacement within 10 days in the event of rejection of any part or function of the hardware, software, field wiring and network configuration systems.

G. All data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30-day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.

H. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as: Availability in percent = 100 * (Total Testing Time – Down Time) / Total Testing Time

I. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided shall not contribute to the availability test times above.

J. Throughout the duration of the 30-day SAT, no software or hardware modifications shall be made to the system without prior approval from the Owner and Engineer.

K. Upon successful completion of the 30-day operation test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.

L. Certification of Installation: Following successful completion of the 30-day test, the PCSS shall issue a Certification of Installation. Certification shall be on PCSS corporate letterhead and signed by an officer of the firm. Certification shall state that the process control system

has been completed in conformance with plans and specifications. Certification shall be submitted to the Engineer as specified herein.

END OF SECTION

SECTION 40 50 30

WATER QUALITY ANALYZERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes requirements for materials, testing, and installation of chlorine residual analyzers, pH/temperature analyzers, and turbidimeters.

1.2 RELATED WORK

A. Section 26 05 00– Basic Electrical Materials and Methods

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 53 – Electrical Identification

D. Section 40 50 00 – Instrumentation and Controls General Provisions

E. Section 40 50 01 – I&C Testing

1.3 REFERENCES

A. International Society of Automation (ISA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data and detail drawings showing dimensions, materials of construction, measurement range, electrical interfaces and protocols, and mounting requirements.

C. Submit list of accessories and instrument options.

PART 2 PRODUCTS

2.1 GENERAL

A. 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.

B. Signal isolators shall be provided where required.

C. All products shall be UL listed.

2.2 AMPEROMETRIC CHLORINE RESIDUAL ANALYZERS

A. The chlorine residual analyzer and controller shall be the following manufacturer's or equal.

1. Evoqua Water Technologies/Wallace & Tiernan – Depolox 3

2. Hach CLF10sc

3. Prominent D1C

B. The analyzer shall provide continuous measurement of the free chlorine residual via amperometric measurement technology.

C. The free chlorine analyzer shall use a bare electrode type cell with a flow cell assembly and internal flow regulator. The analyzer shall have also have a pH sensor in the flow cell to provide a pH compensated free chlorine measurement without the use of a buffer.

D. The analyzer shall be housed in a NEMA 4X enclosure.

E. The analyzer shall be microprocessor-based with solid state circuitry and shall output a proportional 4 to 20 mA signal linear to free chlorine residual.

F. The analyzer shall include a built-in simulator to verify calibration, analog to digital signal conversion, processing, outputs, and alarms.

G. The analyzer shall include built in self-diagnostics to display error messages including questionable calculation results, insufficient data, excessive input noise, input measurement, or calculated results out of range.

H. The analyzer shall include a minimum of three standard optically isolated 4 to 20 mA analog outputs, field programmable over any portion of the analyzer range

I. The analyzer shall incorporate two standard SPDT relay alarms, with contacts rated for 5 amp resistive loads at 115V AC power. Alarm options shall include concentration set point, analyzer system warning, and analyzer system shut down.

J. The analyzer shall provide automatic compensation for the samples temperature.

K. Performance requirements:

1. Measurement range: Selectable but not less than 0 to 5 mg/L free or total residual chlorine.

2. Accuracy: ± 2% of full scale ±0.01 mg/L, whichever is greater.

3. Precision: 5% of reading or 0.01 mg/L, whichever is greater

4. Sensitivity: 0.01 mg/L or 1 % of full scale, whichever is greater.

5. Repeatability: 0.01 mg/L or 2 % of full scale, whichever is greater.

6. Stability: 2% percent of full scale for 1 month.

7. Response Time:

   a. Free Chlorine: 90% of change within 20 seconds after sample entry

8. Sampling rate: Continuous.

9. Sampling flow:

   a. Free Chlorine: 33 ± 5 lph

10. Inlet pressure: 2 to 60 psi.

11. Inlet sample temperature:

    a. Free Chlorine: 32 to 122 degrees F

2.3 PH ANALYZERS

A. Provide pH sensor with a combination pH/reference electrode with temperature compensation. The sensor shall be flow-through type. The sensor shall consist of a sensor housing with 3/4-inch NPT male connection, electrodes, reference junction, and 10 feet of interconnecting cable.

B. Provide LCD indicating analyzer transmitter including integral preamplifier with solid-state electronics for continuous pH and temperature measurement of an aqueous solution over the range of 2 to 12. All readings shall be automatically compensated for temperature variations between 32°F and 212°F with an accuracy of ±0.01 pH units. Provide output signal of 4- to 20-mA d-c for remote indication or control. The analyzer shall utilize a four-wire transmitter. Housing shall be NEMA 4X suitable for wall, panel, or 2-inch pipe stand mounting.

C. The pH sensor shall be that manufactured by Rosemount Model 3900pH with indicating analyzer transmitter Model 1056 pH or equal.

D. Furnish mounting hardware as shown in drawings. Otherwise provide mounting hardware as recommended by manufacturer. Materials shall be 304 stainless steel or fusion bonded epoxy carbon steel unless otherwise noted in drawings. Anchors and fasteners shall be 316 stainless steel.

2.4 TURBIDIMETERS

A. Provide an instrument for continuous, online monitoring of turbidity in water that includes predictive diagnostics capability to monitor instrument status using USEPA Approved Hach Method 10258.

B. The sensor shall utilize a laser-based 360° x 90° optical system that measures turbidity from multiple different angles. The sensor shall utilize continuous particle removal using a vortex created by the fluid path. Shall utilizes an identical laser-based optical system that matches the laboratory turbidimeter direct comparison between laboratory and online measurements. Shall include capability to actively monitor all internal components and present diagnostics on the overall health of the turbidimeter and time to next required maintenance. When connected to a predictive diagnostics capable controller the overall status of instrument performance is displayed as a percentage value via a measurement indicator. When connected to a predictive diagnostics capable controller the overall time remaining until maintenance tasks are due is displayed in days.

C. Furnish laboratory turbidimeter with the same 360° x 90° detection system as the online turbidimeter, for validation of readings from the online turbidimeter.

D. Locate the interface module near the sensor and provide continuous direct reading of turbidity in Nephelometric Turbidity Unit (NTU). The turbidimeter shall be capable of measuring turbidity from 0.0002 to 700.0 NTU. The accuracy shall be ±2% of reading or ±0.01 NTU (whichever is greater) from 0 to 40 NTU. The meter shall have initial response time less than 30 seconds at 100ml/minute sample rate.

E. The interface module shall provide two optically isolated 4 mA-20 mA outputs. The output span shall be field programmable over any portion of the 0 NTU to 100 NTU range. Power requirements shall be 120-volt a-c, 60 hertz. The module shall be housed in a NEMA 4X enclosure. The interface module shall have a built-in data logger with the storage capacity to store data on 15-minute intervals for up to 6 months with two sensors per module.

F. The turbidimeter shall include a 2-year warranty.

G. Turbidimeters shall be manufactured by Hach Model TU5300sc with SC200 Interface Module or approved equal.

PART 3 EXECUTION

3.1 MANUFACTURER'S FIELD SERVICES

A. Provide Manufacturer's services at the jobsite for one day to advise during start-up, testing, and adjustment of the equipment; and to instruct the Owner in the proper operation of the equipment.

3.2 FIELD OR SITE QUALITY CONTROL

A. Operate each analyzer using the built-in simulator for two hours to simulate the full range of operating conditions and test alarm responses.

3.3 INSTALLATION

A. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents.

B. All items shall be mounted and anchored using Type 316 stainless steel hardware unless otherwise noted.

C. All instruments shall be rigidly secured to walls or a backboard as shown on the drawings.

END SECTION

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SECTION 40 51 20

PLC HARDWARE AND SOFTWARE

PART 1 –– GENERAL

1.01 SCOPE OF WORK

A. This Section includes programmable logic controllers (PLCs) for control of process equipment, process oriented machinery, and process systems for both Well #35 and communication with the arsenic control panel via Modbus TCP/IP. This PLC shall use Modbus serial to communicate with the City's HSQ RTU onsite for SCADA communication.

1.02 RELATED WORK

A. Section 40 51 30 Human Machine Interface (HMI)

B. Section 40 51 50 Control Panels and Panel Equipment

C. Section 40 96 32 Control Loop Descriptions

1.03 SUBMITTALS

A. Refer to Section 40 50 00.

B. Product Data: For each type of PLC, include dimensions, mounting arrangements, and weights. Also, include manufacturer's technical data on features, performance, electrical ratings, characteristics, and terminal connections.

C. Operation and Maintenance Data: Provide literature detailing routine maintenance requirements (if any) for each PLC component including:

1. System specifications
2. Electrical power requirements
3. Application considerations
4. Assembly and installation procedures
5. Power-up procedures
6. Programming procedures
7. Explanation of internal fault diagnostics
8. Shut down procedures
9. Recommended spare parts list

1.04 REFERENCE STANDARDS

A. ASTM D999-91: Vibration

B. (CFR) Title 47, Part 18 (European EN 55011 (formerly CISPR 11))

C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations

D. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock

E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques

1. Part 4-2: Electrostatic discharge immunity test
2. Part 4-3: Radiated, radio-frequency, electromagnetic field immunity test
3. Part 4-4: Electrical fast transient/burst immunity test
4. Part 4-5: Surge immunity test
5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields

F. IEC 61131-3: Programmable controllers - Part 3: Programming languages

G. IEC 801-3: RFI Immunity

H. IEC 801-5: Ground Continuity

I. IEC 801-2: Electrostatic Discharge

J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

K. MIL STD 461B CS02: RFI/EMI Susceptibility

L. NEMA Pub No ICS2-230.42: Showering Arc Test

M. NSTA Project 1A

N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages)

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall be capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. The programmable controller and all of the corresponding components within the family of controller products shall be manufactured by a company who regularly manufactures and services this type of equipment.

C. The manufacturer shall comply with ISO9001 standards for "Quality Systems- Model for Quality Assurance in Design/Development, Production, Installation, and Servicing".

D. The manufacturer shall provide complete technical support for all of the products. This shall include factory or on-site training, regional application centers, local or factory technical assistance, and a 24/7/365 technical support phone service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.

B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect

the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.07 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Fixed I/O: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.

D. CPU: Central Processing Unit

E. DI: Discrete Input

F. Distributed I/O: Hardware specially designed to function as Remote I/O.

G. DO: Discrete Output

H. HMI: Human-Machine Interface

I. I/O Input and/or Output

J. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.

K. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.

L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller

O. Remote I/O: I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.

P. SCADA: Supervisory Control and Data Acquisition

1.08 SPARE PARTS

A. Refer to Section 40 50 00.

B. All spare parts shall be packaged to prevent damage during long-term storage. Identify all packages with indelible markings on the exterior describing contents.

C. Provide complete ordering information including manufacturer, part number, part name, hardware and software revision levels, and equipment for which the part is to be used.

1.09 SPARE I/O

A. Each I/O drop and I/O location shall include at least 20 percent (minimum of four) points of each type required (AI, AO, DI, and DO) for future use. The spares shall be the same type of I/O modules supplied. These signals shall count toward the 20 percent spare point requirement for each Remote I/O unit specified.

B. Spare output points that require the use of an external relay shall include provision of that external relay.

C. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

1.10 MANUFACTURER SUPPORT

A. Provide a written proposal for a manufacturer support agreement for PLC hardware and software for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the OWNER. At a minimum, this agreement shall provide the OWNER with:

1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
2. Access to the manufacturer's technical support website.
3. Software and firmware updates.

B. At the beginning of the specified 12 month support agreement, the PCSS shall send a letter to the Engineer and OWNER, informing them of the expected termination date of the 12 month support agreement and costs for purchasing additional years of support.

PART 2 - PRODUCTS

2.01 GENERAL:

A. The PLC shall:

1. Collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.
2. Be able to have its program downloaded from a remote workstation over a network, or locally programmed from a portable laptop computer.
3. Allow for the expansion of the system by addition and configuration of hardware.

B. Executive firmware shall be stored in Flash memory and can be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.

C. Each discrete point shall have a light emitting diode to indicate point status. Green shall indicate that the point is logic level “1”, also referred to as “on” or “high”.

D. The PLC shall utilize Ethernet protocols that meet the following:

1. Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
2. Devices must utilize embedded web pages, or a physical means such as DIP switches, to be recognized and properly addressed on the network. Ethernet protocols that require network management software, or utilize configuration files that must be downloaded to Ethernet devices, for proper network addressing, and recognition are not acceptable.

3. Will not rely on third party vendors to meet the above criteria.

2.02 PLC PROGRAMMING REQUIREMENTS:

1. All specified PLC platforms will be programmed using the same programming software package. PLCs that use multiple software programming packages under similar trade names will not be accepted.
2. The system shall be designed to execute all languages without a significant decrease in processing speed.
3. Programming software shall have integrated tools for network configuration, and communication capabilities. PLC's that use separate programming, communication, and network configuration software shall not be accepted.

2.03 PLC ENVIRONMENTAL REQUIREMENTS:

A. The PLCs must meet or exceed the following environmental requirements:
   1. Minimum temperature range:
      a. Operating: 0-55^{o} C (+32 to +131^{o}F)
      b. Storage: -25 to +70^{o} C (-13 to +158^{o}F)
   2. Relative humidity: 30 to 95% non condensing.
   3. Altitude:
      a. Operation 0-6,500 feet minimum
      b. Storage 0-9,800 feet minimum
   4. Degree of protection: NEMA 1 (IP20)
   5. Vibration resistance in accordance with at least one of the following:
      a. Installed rating:
         1) DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and
         2) Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.
      b. In compliance with IEC 60068 and IEC 61131.
   6. Shock resistance: 147m/s^{2} for 11ms.

2.04 BASIS OF DESIGN

A. The basis of design is the Automation Direct Productivity 2000 series PLC.

B. Description: A chassis mount PLC designed for up to 2048 points of I/O. The system will execute logic in a single processor module.

C. The PLC shall:
   1. Collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.
   2. Be able to have its program downloaded from a remote workstation over a network, or locally programmed from a portable laptop computer.
   3. Allow for the expansion of the system by addition and configuration of hardware.

D. Executive firmware shall be stored in Flash memory and can be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.

E. Each discrete point shall have a light emitting diode to indicate point status. Green shall indicate that the point is logic level “1”, also referred to as “on” or “high”.

F. The PLC shall utilize Ethernet protocols that meet the following:

1. Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
2. Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)
3. Programming software will have embedded network configuration tools that utilize FDT/DTM technologies. PLC systems that have the PLC programming and network configuration tools in separate software will not be acceptable.
4. Will not rely on third party vendors to meet the above criteria.

G. Processor Features:

1. Each processor will be capable of being programmed via serial communications with a PC. The processor will have a display block with colored indicator lamps for RUN (Green), ERR (Red), I/O (Red), and TER (Yellow). Processors with an integrated Ethernet port shall have colored indicator lamps for RUN (Green), ERR (Red), COL (Red), STS (Yellow), TX (Yellow), and RX (Yellow). The processor shall be programmable through the USB port of a personal computer using a direct cable scheme. The acceptable processors are detailed below:
    a. 30.4KB of base program and data memory.

H. General I/ O Cards: I/O modules shall be plugged into a backplane. All modules shall be enclosed in plastic housing. All field wiring shall be to a removable terminal strip that will permit removal and replacement of a module without disturbing the field wiring or any other I/O modules. They will be as follows:

1. Analog Inputs: All analog input cards will offer isolation between channels, between bus and channels, and between channels and ground.
    a. Four (4) channel +/- 10V, 0-20mA, B,E Thermocouple, Pt 100, Pt 1000, Ni 1000, 2 or 4-wire temperature probes input card.
    b. Eight (8) channel +/- 10V, 0-20mA input card
    c. Sixteen (16) channel +/- 10V, 0-20mA input card.
2. Analog Outputs: All analog output cards will offer isolation between channels.
    a. Four (4) channel +/- 10V, 0-20mA output card
    b. Eight (8) channel +/- 10V, 0-20mA output card
3. Discrete Inputs:
    a. Eight (8) channel 24VDC input card
    b. Sixteen (16) channel 24VDC input card
    c. Thirty two (32) channel 24VDC input card
    d. Sixty-four (64) channel 24VDC input card

e. Sixteen (16) channel 120VAC input card

4. Discrete Outputs:
   a. Eight (8) channel 24VDC (0.5A/channel) protected transistor output card
   b. Sixteen (16) channel 24VDC (0.5A/channel) protected transistor output card
   c. Eight (8) channel 24VDC/240VAC relay output card
   d. Sixteen (16) channel 24VDC/240VAC relay output card
   e. Sixteen (16) channel 48-240VAC (1A/channel) protected triac output card.

I. Communication Capabilities: The PLC shall support the following without the need for third party modules
   1. Ethernet with Fast Device Replacement (FDR) capability,
   2. Serial protocols including Modbus, and Unitelway.
   3. Modbus TCP and EtherNet I/P protocols
      a. PLC will have an Ethernet card capable of scanning I/O for up to 64 stations. They will also have global data capabilities, and an integrated FDR server for automatic reconfiguration. Additionally the card will have an alarm display, a graphic data editor, and handle custom web pages.

J. Power Supplies: The PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules. There shall be a single power supply per chassis. The power supplies shall be available in both 24-48VDC and 100-240VAC models.

K. Chassis: The PLC shall have chassis to mount processors, power supplies, and other applicable cards. The chassis shall come in 3, 4, 6 and 9 position configurations. The cards will be secured to the chassis via a screw connection.

PART 3 -EXECUTION

3.01 GENERAL INSTALLATION

A. Maintain area free of dirt and dust during and after installation of programmable controller products.

B. Anchor PLCs within enclosures as recommended by the PLC manufacturer.

C. Ventilation slots shall not be blocked, or obstructed by any means.

D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Install in accordance with manufacturer’s instructions.

F. Unload, unpack and transport equipment to prevent damage or loss.

G. Replace damaged components as directed by Engineer.

3.02 PANEL LAYOUT

A. Coordinate size and configuration of enclosure to meet project requirements. Drawings indicate maximum dimensions for PLCs, minimum clearances between PLCs, and adjacent surfaces and other items.

B. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.

   1. Provide spacing around PLC as required by the PLC manufacturer to insure adequate cooling. Insure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.

   2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.

   3. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.

   4. PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.

C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.

D. Control panel designer shall insure that communication signals, 4-20mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

E. Each PLC (including all I/O) shall be powered from an UPS power conditioning system.

F. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single module will not disable all mechanical components associated with the process redundancy (e.g., inputs and outputs for redundancy device 1 shall reside on different modules than the inputs and outputs for redundancy device 2, etc.), irrespective of the number of used points resulting from this configuration.

G. Provide all required cables, cords, and connective devices for interface with other control system components.

END OF SECTION

SECTION 40 51 30

HUMAN MACHINE INTERFACE (HMI) HARDWARE

PART 1 — GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and installed. Complete as shown on the Drawings and as specified herein.

B. The PCSS shall furnish the labor and materials required to install and bring into operation HMI hardware.

1.02 RELATED WORK

A. Refer to Division 26 specifications.

B. Refer to Section 40 50 00.

1.03 SUBMITTALS

A. Refer to Section 40 50 00.

1.04 REFERENCE STANDARDS

A. Refer to Section 40 50 00.

1.05 QUALITY ASSURANCE

A. Refer to Section 40 50 00.

1.06 SYSTEM DESCRIPTION

A. Provide all HMI hardware as identified in the Contract Documents.

1.07 PROJECT/SITE REQUIREMENTS

A. Refer to Section 40 50 00.

1.08 MAINTENANCE

A. Refer to Section 40 50 00.

1.09 WARRANTY

A. Refer to Section 40 50 00.

1.10 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 40 50 00.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Automation Direct C-More EA9 series

2.02 GENERAL

A. Provide Human Machine Interfaces located on the face of the PCM or vendor control panel as indicated on the Drawings or as scheduled herein.

B. NEMA 4X rated where located outdoors.

C. NEMA 12 rated where located indoors.

D. Human Machine Interface consists of graphical display screen with operator input capabilities.

E. Capable of stand-alone operation in conjunction with 1 PLC.

F. Equipped with data network communication capabilities.

2.03 DISPLAY

A. Type: Color, TFT LCD screen.

B. Resolution:

1. 10 inch screen:

a. 1024 x 600 pixels.

b. 18-bit color graphics.

C. Size: As scheduled and shown on Drawings.

D. Easy display viewing at any angle in various ambient light conditions.

E. Operator Input: Configurable touch screen.

F. Screen Update speed: The screen update speed and screen change speed less than 1 second.

G. Provide following features for outdoor use:

1. Anti-glare screen overlay.

2.04 GRAPHIC CONFIGURATION:

A. Easily configured graphics by:

1. Portable laptop computer both locally and via the PLC data network.

2.05 MEMORY:

A. 26 MB RAM.

2.06 COMMUNICATIONS:

A. RS232.

B. Ethernet.

2.07 ENVIRONMENT:

A. Temperature: 0 to 50 degrees Celsius.

B. Relative Humidity: 10 to 90 percent.

2.08 ELECTRICAL:

A. Power Supply:

1. 120 VAC.

2.09 ACCESSORIES

A. Human Machine Interface Programming Software:

B. Provide sun shield for outdoor installations.

PART 3 — EXECUTION

3.01 INSTALLATION

A. All components of the control system including all data network cables are the installation responsibility of the contractor unless specifically noted otherwise.

END OF SECTION

SECTION 40 51 50

CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1 –– GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 40 50 00.

B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.

C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.

D. Furnish the following panels and consoles. Each panel shall be supplied with full sub-panels and side panels as required.

1.02 RELATED WORK

A. Refer to Section 40 50 00.

1.03 SUBMITTALS

A. Refer to Section 40 50 00.

1.04 COORDINATION MEETINGS

A. Refer to Section 40 50 00.

1.05 REFERENCE STANDARDS

A. Refer to Section 40 50 00.

1.06 QUALITY ASSURANCE

A. Refer to Section 40 50 00.

1.07 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 40 50 00.

1.08 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 40 50 00.

1.09 MAINTENANCE

A. Refer to Section 40 50 00.

1.10 SPARE PARTS AND TEST EQUIPMENT:

A. Refer to Section 40 50 00.

1.11 WARRANTY

A. Refer to Section 40 50 00.

PART 2 - PRODUCTS

2.01 GENERAL

A. Refer to Section 40 50 00.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 40 50 00.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.

C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.

E. The panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.

F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer’s recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

H. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black [White] against a White [Black] background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless steel screws for cabinet mounted nameplates

4. For every panel, provide a panel nameplate with a minimum of 1" high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.

5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

I. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.

3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.

4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.

5. Installation of panel components shall conform to component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure

1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch and heavy duty stainless steel locking handle. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.
3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
4. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

B. Freestanding and Floor-Mounted Vertical Panels

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of 316 stainless steel. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels

1. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not strength. All NEMA 4X rated wall mounted panels shall be constructed of 316 stainless steel.

D. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.
4. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.

5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

E. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

F. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.05 ENVIRONMENTAL CONTROL

A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

B. PCSS shall submit heat dissipation calculations for every control panel.

C. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

D. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

E. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

F. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.

G. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

1. Sun shields shall be fabricated from minimum 12 gauge aluminum. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.

2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.

3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.

4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.
5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.

H. All outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH [100] [200] [400] [800] Watts, [115] [230] Volt, 50/60 HZ or equal.

2.06 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.
4. Terminations
    a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
    b. Multi-level terminal blocks or strips are not acceptable.

c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.

d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 40.

e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.

f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.

g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.

h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.

5. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:

   a. Incoming 120 VAC Hot - Black

   b. 120 VAC Hot wiring downstream of panel circuit breaker – Red

   c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe

   d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Division 26.

   e. 120 VAC neutral - White

   f. Ground - Green

   g. DC power or control wiring – Blue

h. DC analog signal wiring – Black (+), White (-)

i. Foreign voltage – Yellow

7. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 40 50 00.
8. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.
9. Provide 24VDC power supplies to power field instruments and panel devices. 24VDC power supplies shall be as specified in this Section.
10. Use of adhesive backed cable tie mounts is not acceptable. Cable ties shall be permanently fixed to the panel structure, as needed for controlling cable routing within the panel.
11. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
12. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
13. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.
14. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
15. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
16. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 40 50 00.
17. All microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to appropriate Section in Division 40).
18. Each panel shall be provided with a circuit breaker to interrupt incoming power. Provide a minimum of two (2) spare 20-amp breakers.
19. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 26.

B. Pneumatic Tubing

1. Refer to Section 40 50 00.

2. Pneumatic tubing shall be a minimum of 1/4-inch O.D. 316 stainless steel with compression fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes.
3. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.
4. A screened vent shall be provided on all enclosures using pneumatic instruments.
5. All pneumatic tubing shall be routed in separate bundles or wireways, and shall be separated from all electrical wiring by a minimum of 3-inches.

C. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26, or shown on the Drawings shall be provided under this Section.

D. The orientation of all devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the engineer.

E. Purge system for enclosures located in hazardous areas.

2.07 ELECTRICAL COMPONENTS

A. Refer to Division 26.

B. The control panel shall be provided with a main power circuit breaker and individual fuses for each 120VAC and 24VDC logical circuit.

C. All operating control devices and instruments shall be securely mounted on the exterior door. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Contract Drawings.

D. The control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.

2.08 PILOT TYPE INDICATING LIGHTS

A. Type: Energy efficient Solid State LED Lamps.

B. Functional:

1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.
2. Lights supplied with 120V AC power shall have integral reduced voltage tansformers.
3. Lamps shall be replaceable from the front of the unit.

C. Physical:

1. Lens color:
   a. Running, on, open – Red.
   b. Stopped, off, closed – Green.
   c. Alarm – Amber.
   d. White - Power on

e. Blue - All other status indications not covered by the above

f. Lens caps shall be approximately 0.46 inch diameter. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.

D. Manufacturer(s):

1. Cutler-Hammer.
2. Allen Bradley.
3. Equal.

2.09 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:

1. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

B. Functional:

1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC.
2. Pushbuttons shall have flush type operators.
3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):

1. Cutler-Hammer.
2. Allen Bradley.
3. Equal.

2.10 POTENTIOMETER

A. Type:

1. Device shall be heavy-duty 30 mm oil tight type.

B. Functional:

1. 270 degree dial
2. Rated for 1,000 ohms.

C. Physical:

1. Mounting: Suitable for panel mounting
2. NEMA 4X rating; escutcheon plates scaled in engineering units.

D. Manufacturer(s):

1. Allen Bradley Co.

2. Cutler-Hammer.
3. Equal.

2.11 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:
   1. General purpose plug-in type.
B. Functional:
   1. Contact arrangement/function shall be as required to meet the specified control function; mechanical life expectancy shall be in excess of 10 million.
   2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
   3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
   4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.
C. Physical:
   1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.
D. Options/Accessories Required:
   1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
   2. Provide mounting rails/holders as required.
E. Manufacturer(s):
   1. IDEC.
   2. Allen Bradley.
   3. Potter & Brumfield.
   4. Equal.

2.12 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Type:
   1. Solid state, ASIC technology, electronic type.
B. Functional:
   1. Input: 4-20 mA.
   2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.
   3. Accuracy: 0.1 percent.
   4. Protection: Provide RFI protection.
   5. Deadband: Adjustable between 0.1 and 5.0 percent of span.

6. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.

C. Physical:

1. Mounting: DIN rail.

D. D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.13 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:

1. Solid state, ASIC technology; electronic type.

B. Functional:

1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Outputs: Current or voltage as required.
4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.
5. Adjustments: Zero and span adjustment shall be provided.
6. Protection: Provide RFI protection.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.14 SIGNAL SELECTORS, COMPUTATION, AND CONDITIONING RELAYS

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Inputs: 4-20 mA.
2. Outputs: 4-20 mA.
3. Protection: Provide RFI protection.

4. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as Required.
5. Isolation: All inputs, outputs, and power supplies shall be completely isolated.
6. Accuracy: 0.35 percent of span.
7. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:
1. Mounting: DIN rail.

D. Manufacturer(s):
1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.15 INTRINSICALLY SAFE RELAYS

A. Type:
1. Relays shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

B. Options Required:
1. Relays shall match power supply provided.
2. Relays shall be located in non-hazardous areas.

C. Manufacturer(s):
1. Consolidated Electric.
2. Gems Safe-Pak.
3. Warrick Controls.
4. R. Stahl, Inc.
5. Equal.

2.16 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:
1. Type:
a. Beacon alarm light.
2. Physical:
a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.
b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.
3. Manufacturer(s):
a. Federal Signal.

b. Edwards.

c. Wheelock.

d. Equal.

B. Alarm Horn:

1. Type:

a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.

2. Manufacturer(s):

a. Federal Signal Corp.

b. Edwards Co.

c. Benjamin.

d. Equal.

2.17 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

C. Manufacturer(s):

1. P&F.

2. Gems.

3. Unitech.

4. Equal.

2.18 24 VDC POWER SUPPLIES

A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

B. The 24 VDC power supply shall meet the following requirements:

1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

2. Output voltage: 24 VDC.

3. Output voltage adjustment: 5 percent.

4. Line regulation: 0.05 percent for 10 volt line change.

5. Load regulation: 0.15 percent no load to full load.

6. Ripple: 3 mV RMS.

7. Operating temperature: 32 to 140 degrees Fahrenheit.

C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.

D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

G. Manufacturer(s):

1. Phoenix Contact – Quint Series
2. PULS.
3. Lambda.
4. Equal.

2.19 DIGITAL PANEL METER

A. Type:

1. Electronic, 3.5 digit, 0.56 inch high efficiency LED display.

B. Operation:

1. To accept 4-20 mA DC input signal and provide indication in Engineering Units of measured variable.

C. Functional:

1. Power supply: 115 VAC, plus or minus 10 percent, 50/60 Hz, 10 VA.
2. Input: 4-20 mA DC into 100 ohms.
3. Indication: 0.56 inch LED display.

D. Physical:

1. Case size nominal 2.5 inch high by 5 inch wide by 6 inch deep.
2. Case type: watertight and dust-tight (NEMA 4X).
3. Mounting: flush panel suitable for high density mounting arrangements.

E. Performance: Linear input accuracy plus or minus 0.05 percent of calibrated span, plus or minus 1 count.

F. Manufacturer(s):

1. Precision Digital.
2. Red Lion.
3. Equal.

2.20 MEDIUM OPERATOR INTERFACE TERMINAL

A. Description: Medium Operator Interface Terminals shall have viewable screen size of eleven (11) inches. The basis of design is the Schneider Electric Magelis XBT-GT terminal series.

B. A color STN screen with 4096 solid colors. The screen shall have a 640x480 pixel (VGA) resolution, with a backlighting service life of 50,000 hours of continual usage. There shall be an embedded analog touch sensitive zone with a resolution of 1024x1024. The screen shall have eight (8) levels of brightness, and eight (8) levels of contrast via tactile feedback.

C. Communication Ports: The Operator Interface Terminals shall have an RJ-45 port, and an integral 9-way male SUB-D connector, dedicated to serial communications shall be provided. The 9-way SUB-D connector shall support RS232/RS485 Communications. The RJ-45 port shall support RS485. Additionally, two (2) type A host USB connectors shall be provided for application downloading and peripheral use. Furthermore, the terminal will be supplied with an integral RJ-45 port dedicated to 10BASE-T/100BASE-TX Ethernet TCP/IP communications. Operator Interface Terminals relying on the same port for communications and downloading shall not be acceptable.

D. Communication Protocols. The Operator Interface shall be supplied with Modbus or Modbus TCP/IP.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 40 50 00.

3.02 TESTS

A. Refer to Section 40 50 00.

END OF SECTION

SECTION 40 91 25

MAGNETIC FLOWMETERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section describes requirements for magnetic flowmeters included on granular activated carbon vessel systems for monitoring treated water and backwash flow and on the backwash recycle pump.

1.2 RELATED WORK

A. Section 09 90 00– Painting and Coating

B. Section 40 05 00– Pipe and Fittings

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME)

B. American Society for Testing and Materials (ASTM)

C. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit manufacturer's catalog data and detail drawings showing dimensions, pressure rating, coatings, and meter parts and describe by material of construction specifications (such as AISI, ASTM, SAE, or CDA) and grade or type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flow meters shall be Siemens Sitrans FM electromagnetic flow meters with MAG 5100 W sensor and MAG 5000 transmitter or pre-approved equal.

2.2 GENERAL METER DESIGN

A. The complete flowmeter shall consist of a flow sensor and an associated transmitter.

B. Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear

with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter and flowmeter grounding rings.

C. Sensor and transmitter enclosures shall have NEMA 4X environmental rating.

2.3 SENSOR DESIGN

A. Provide stainless steel grounding rings and grounding electrodes per manufacturer's requirements.

B. Sensor shall be rated for a minimum of 150 psi unless otherwise noted.

C. Sensor ends shall be ANSI B16.5 or AWWA C-207 flanged connections.

2.4 SENSOR MATERIALS OF CONSTRUCTION

A. Housing shall be ASTM A 105 carbon steel with corrosion resistant epoxy coating and flanged connections.

B. Measuring tube shall be 304 stainless steel with EPDM rubber liner complying with ANSI/NSF Standard 61.

C. Electrodes shall be Hastelloy C.

2.5 INDICATOR / TRANSMITTER DESIGN

A. The microprocessor-based signal converter/transmitter shall be mounted to the sensor or remotely mounted as indicated under "service conditions".

B. The transmitter shall utilize DC pulse technique to drive flux-producing coils. The DC pulse signal from the tube shall be converted to a standardized 4-20 mA signal into a minimum of 700 ohms.

C. Max measuring error: +/- 0.4%

D. Include a 3-line LCD alpha numeric display with backlight for flowrate, percent of span, and totalizer. The indicator shall be equipped with an integral sun screen to protect the display.

E. Transmitter shall have the following inputs and outputs: 1 digital input, 1 current output, 1 pulse/frequency output, 1 relay output. Transmitter shall support HART communication.

F. Power supply: 115 – 230 V AC 60 Hz.

G. Be capable of measuring flow in both directions.

2.6 INTERCONNECTING CABLE

A. The interconnecting cable between the sensor and the transmitter shall be furnished by the magnetic flowmeter manufacturer.

2.7 SERVICE CONDITIONS

Tag No.	Service	Size (Inches)	Local/Remote Indicator	Flow Range (GPM)
10-FE/FIT-001	Well Pump	16”	Local	1,000 – 3,000gpm
30-FE/FIT-001	Backwash Supply	8”	Local	1,000 – 3,000gpm
30-FE/FIT-002	Bypass Line	8”	Local	500 – 2,000 gpm
40-FE/FIT-001	Equalization Tank Outlet	4”	Local	0 – 200 gpm

A. Note filter supplier shall provide individual flowmeters on each filter.

PART 3 EXECUTION

3.1 INSTALLATION

A. Magnetic flow meters shall be installed and supported in accordance with the manufacturer’s installation instructions.

B. Meters shall be properly grounded to the adjacent pipe to ensure full pipe grounding.

3.2 PAINTING AND COATING

A. Field coat the exterior of the flow meter sensor housing per Section 09 90 00, System No. 2. Coating color to match adjacent piping.

END OF SECTION

SECTION 40 91 30

PROCESS PRESSURE AND LEVEL INSTRUMENTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section describes requirements for pressure gauges; pressure switches, pressure transmitters, and ultrasonic level transmitters.

1.2 RELATED WORK

A. Section 26 05 00– Basic Electrical Materials and Methods

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 53 – Electrical Identification

D. Section 40 50 00 – Instrumentation and Controls General Provisions

E. Section 40 50 01 – I&C Testing

1.3 REFERENCES

A. International Society of Automation (ISA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data and detail drawings showing dimensions, materials of construction, measurement range, electrical interfaces and protocols, and mounting requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Unless otherwise noted transmission analog signals shall be 4 mA to 20 mA.

B. Unless otherwise noted the combined power supply and transmitter loops shall present a voltage signal of 1- to 5-volt DC.

C. Signal isolators shall be provided where required.

D. All products shall be UL listed.

2.2 PRESSURE GAUGES

A. Pressure gauges shall be ASME B40.1 Grade 2A bourdon tube type with an accuracy of ½% of full scale. Gauges shall be non-liquid filled unless liquid filled is specifically called out on the drawings.

B. Dial size shall be 4-1/2" unless otherwise noted on the drawings. Case and ring shall be constructed of fiberglass reinforced thermoplastic. Window shall be glass. Dial shall be aluminum with a white background and black pressure scale. Bourdon tube and movement shall be 300-series stainless steel.

C. Weather protection of dry cases shall conform to IP54; liquid filled cases shall conform to IP 65.

D. Process connection size shall be ½ inch NPT.

E. Liquid filled gauges shall be filled with glycerin.

F. Pressure gauge ranges shall be identified on the drawings directly or by Type Number as listed below.

Type Number	Pressure Range
1	0 – 15 psig
2	0 - 30 psig
3	0 – 60 psig
4	0 – 100 psig
5	0 – 160 psig

G. Pressure gauges shall be Ashcroft 1259 or equal.

2.3 PRESSURE SWITCHES

A. Pressure switches shall be of the bourdon tube type suitable for operation up to the maximum pressure of the specified operating range.

B. Both single limit (SPST) and two-limit (SPDT) switches shall utilize non-mercury metal contact snap switches. Switches shall have a calibrated setpoint indicating scale and shall provide indication of on/off position. Separate external adjustment of each operating point shall be possible.

C. Wetted materials shall be 403 or 316 stainless steel wetted materials. Switch shall be housed inside of a weatherproof enclosure suitable for vertical outdoor uncovered mounting.

D. Switches shall have a repeatability equal to ± 1.5% of the full operating range. The deadband shall be adjustable over the full-scale.

E. Process liquid connections shall be ½" male NPT unless otherwise noted on the drawings.

F. Differential pressure switches shall be as described above and shall have opposing bellows type actuating.

G. Switches shall be Series DA/DS or DP (for differential pressure) as manufactured by Dwyer Instruments or equal.

H. Pressure switch ranges shall be identified on the drawings directly or by Type Number as listed below.

Type Number	Pressure Range
1	2 – 60 psig
2	1 – 35 psig
3	5 – 100 psig
4	10 – 200 psig
5	10 – 300 psig

2.4 PRESSURE TRANSMITTERS

A. Pressure transmitter shall be solid-state polysilicon pressure sensor with 316L isolating diaphragm. Transmitter shall include LCD display for process measurement and diagnostic messages.

B. Accuracy shall be ±0.075% of calibrated span including the effects of linearity, hysteresis, and repeatability. Total response time shall be 145 milliseconds with a minimum update rate of 20 times per second.

C. If self-diagnostics detect a sensor failure, the analog signal shall be driven either high or low to alert the user.

D. Transmitter housing shall be polyurethane painted aluminum with a NEMA 4X rating. Transmitter shall be suitable for outdoor installation with an ambient temperature range of -40 to 170 ºF and 0 – 100% relative humidity. LCD shall include integral or accessory protection from direct exposure to sunlight.

E. Process connection shall be ½-inch NPT female.

F. Output shall be 4 – 20 mA.

G. External power source shall be 10.5 – 42.4 Vdc. Provide reverse polarity protection.

H. Pressure transducer shall be Rosemount (Emerson Process) 2088 or equal.

I. Pressure transmitter ranges shall be identified on the drawings directly or by Type Number as listed below:

Type Number	Pressure Range
1	0.6 - 30 psig
2	3 - 150 psig
3	16 – 800 psig

2.5 ULTRASONIC LEVEL TRANSMITTERS

A. Sensor shall be a 2-wire loop-powered ultrasonic transmitter that continuously monitors liquid level in tanks and storage vessels. Unit shall be capable of generating, transmitting, receiving and processing ultrasonic signals and converting those signals into a 4 to 20 mA output proportional to the liquid level.

B. Unit shall provide continuous level measurement up to 40 feet in range using auto false-echo suppression for fixed obstruction avoidance. Accuracy shall be the greater of ± 0.15% of range or 0.24 inches. Beam angle shall be ten degrees.

C. Power supply shall be nominal 24V DC, 30 V DC maximum with 550 ohm maximum.

D. Unit shall incorporate internal temperature sensor to compensate for temperature changes. Update time shall be less than five seconds.

E. Unit shall incorporate a local LCD display with bar graph.

F. Unit, including local LCD display, shall be suitable for uncovered outdoor installation with an ambient temperature range of -40 to 170 ºF and 0 – 100% relative humidity. Enclosure shall be constructed of plybutylene terephthalate and provide NEMA 4X protection. Transducer shall be constructed of PVDF.

G. Process connection shall be 2” NPT.

H. Unit shall be programmed using an infrared handheld programmer. Furnish one handheld programmer for use on all ultrasonic level transmitters furnished on the project.

I. Unit shall be Siemens SITRANS Probe LU or equal

PART 3 EXECUTION

A. Instruments shall be installed in easily accessible locations and oriented for ease of reading and maintenance.

B. All instrumentation shall be calibrated and tested after installation. The Contractor shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's instructions. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs. All test equipment and all instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have an accuracy

better than the required accuracy of the instrument being calibrated. Test equipment shall have accuracies traceable to the NIST as applicable.

C. Instruments shall be prepared for use in accordance with manufacturer's instructions after field calibration.

D. All instruments of a given type shall be supplied the same manufacturer.

END SECTION

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SECTION 40 96 31

SCADA CONTROL LOOP DESCRIPTIONS

PART 1 GENERAL

1.1 SECTION DESCRIPTION

A. This section, in conjunction with specific requirements contained in the P&ID drawings, plans and specifications, describes the function of the project controls and instrumentation. The contractor is responsible for providing a finished supervisory control and data acquisition system and associated programming that can accomplish all of the following functions and provides the necessary operator interface to monitor the process, control the process, generate reports, and adjust setpoints as necessary. The system will be based on remote terminal units, manufacturer furnished equipment control panels, and a master control workstation.

B. The control functions described in this section are in addition to any control functions described elsewhere on the plans or specifications. Refer to individual process sheets in the plans for instrumentation IDs and location and the Process and Instrumentation Diagram sheets.

C. All analog instruments shall include the following discrete outputs for use as operator adjustable alarms:

1. Instrument Fail
2. High-high
3. High
4. Low
5. Low-low

D. All software and relay control switches shall include adjustable timer delays.

E. Trend data, including trend curves, for all analog instrument signals from analyzers, flowmeters, transducers, etc. shall be accessible by the operator at the SCADA workstation and HMI.

F. **The contractor shall ensure that the existing water system is not over pressurized during startup. The contractor shall ensure that the system pressure does not exceed 65 psi during startup.**

1.2 RELATED WORK

A. All Division 40 series instrumentation and controls related specifications

B. 46 33 43 Motor Operated Diaphragm Chemical Metering Pumps

C. 46 61 21 Pressure Filters

PART 2 CONTROL LOOP DESCRIPTIONS

2.1 PROCESS 00 – MISCELANEOUS PLANT FUNCTIONS

A. References in these control loop descriptions to “plant” or “treatment plant” shall mean the well pump, filter system, chemical feed systems, and all associated subsystems.

B. The Well 38 facility shall be capable of being operated in two control modes selectable from the SCADA terminal that will:

1. Pressure sustaining control mode (Pressure Mode): Maintain a target programmable distribution system pressure entering the distribution system as measured at ***10-PIT-002***

2. Constant flow control mode (Flow Mode): Maintain a target programable flow from the treatment plant as measured by **10-FE/FIT-001**

C. Plant start-up and shutdown: Provide hand-off-automatic operational mode and pressure-flow control mode selectors .

1. In hand mode, the treatment plant shall start provided that startup is not inhibited by a high-high distribution system pressure ***10-PIT-002***

2. In off mode, the treatment plant shall be off

3. In automatic mode:

a. If Pressure Mode is selected, the treatment plant shall

1) When running, vary the filtration system flow rate to maintain a pressure setpoint at ***10-PIT-002***.

2) When off, it shall turn on when a low pressure (“start pressure”) setpoint is reached at ***10-PIT-002***.

3) When on, it shall turn off when simultaneous low flow and high pressure (“stop flow” and “stop pressure”) setpoints are reached at **10-FE/FIT-001** and ***10-PIT-002*** respectively. This situation represents the treatment plant not being able to produce a flow low enough to avoid over-pressurizing the distribution system.

b. If Flow Mode is selected, the treatment plant shall

1) When running, vary the filtration system flow rate to maintain a flow setpoint at **10-FE/FIT-001**.

2) The treatment plant shall not start automatically in Flow Mode

3) When on, it shall turn off when a high pressure ("stop pressure") setpoint is reached at ***10-PIT-002.***

4. Regardless of which mode the treatment plant is in (Flow or Pressure), it shall shut off if any of the inhibit conditions described elsewhere in this specification occur.

D. All water quality instrument measurements (chlorine residual analyzers, pH probes, turbidity, etc) shall be shown at the SCADA workstation.

2.2 PROCESS 10 - WELL

A. The following analog measurements shall be visible to the operator at the SCAADA workstation and HMI:

1. Well water level ***10-LIT-001***

2. Well flow meter measurement **10-FE/FIT-001**

3. Well pressure transducer ***10-PIT-001*** and Distribution System Pressure ***10-PIT-002***

B. The treatment plant shall shut off should the high or low pressure ***10-PSHL-001*** switch be activated following an adjustable time delay initially set at 2 seconds. The set points for each switch will initially be:

1. High Pressure Pump Shut Off: 80 psi.

2. Low Pressure Pump Shut Off: 25 psi.

C. The treatment plant shall shut off should the flow measured by flow meter ***10-FE/FIT-001*** fall below an operator adjustable low flow measurement following an adjustable time delay. Initial set points are:

1. Low Flow Pump Shutoff: 800 gpm

2. Adjustable Time Delay: 5 seconds

D. Well pump speed shall be automatically controlled to maintain a pressure setpoint at the inlet to the filtration system measured at ***10-PIT-001*** (initial setpoint is 70 psi).

1. Minimum pump speed shall be established through an operator adjustable limit initially set to 48 Hz or 80% of full speed. The purpose of this is to prevent the pump from running dry when operating at too low speed.

2. Pump speed ramp rate shall be established through an operator adjustable limit initially set at 5 Hz per second or slower.

2.3 PROCESS 20 – FUTURE GAC TREATMENT

A. No SCADA System requirements required at this time

2.4 PROCESS 30 – FILTRATION SYSTEM

A. The filter system control interface available at the filter system control panel/HMI shall be mirrored at the SCADA workstation. All control and telemetry functions available at the filter system control panel shall be accessible to the treatment plant operator at the SCADA workstation and HMI.

B. Process 30 (Filter System):

1. The filter system shall be called on and off by SCADA whenever the treatment plant is called on or off.

2. The filter system SCADA screen shall provide easy access to the following information provided by the filter system control panel.

a. Filter system enable status

b. Treatment plant flow rate and pressure setpoint from SCADA to the filter system. Filter system shall allow for operator to manually control flow to each filter.

c. System flow rate summary presenting the following information:

1) Well flow rate measured by ***10-FIT-001***

2) Combined filter flow rate measured by the filter flow meters in both gallons per minute and percentage of well flow.

3) Bypass flow rate measured by ***30-FIT-001*** in both gallons per minute and percentage of well flow.

d. Filter system feedback on the following

1) Status of each filter vessel (filter, standby, backwash, flush to waste)

2) Individual filter flow rates

3) Time since last backwash of each filter

4) Pressure differential across each filter calculated by subtracting the individual filter effluent pressure from the common filter inlet manifold pressure.

5) Filter system valve positions

3. SCADA shall provide a signal to the filter system to inhibit filter backwashing based on the following two criteria

   a. Inadequate supply pressure: if the distribution system pressure measured at ***10-PIT-002*** is below an adjustable limit initially set to 50 psi

   b. Inadequate waste storage volume: if the Equalization tank level ***40-LE/LIT-001*** is above an adjustable limit initially set to 8 feet

C. Process 30 (Filter Bypass System):

1. The operator shall have the ability to manually bypass a portion of the raw water flow around the pressure filters based the total plant flow. The bypass flow would be controlled manually by the Flow Control Valve ***30-FCV-002*** and measured by ***30-FE/FIT-001*** with initial high level alarms initially set at:

   a. High level bypass flow shut off: 1,000 gpm

   b. If the flow measured at **30-FE/FIT-001** exceeds this high level setpoint, the treatment plant shall shut down.

D. Process 30 (Filter Backwash System):

1. The bypass flow rate is controlled manually by the Flow Control Valve ***30-FCV-011*** and measured by ***30-FE/FIT-011.*** Deviation from the preset backwash flow rate (initially to be set at 2,250 gpm), when the filter system is in backwash mode will result in an alarm.

   a. High flow alarm: 2,500 gpm

   b. Low flow alarm: 2,000 gpm

2.5 PROCESS 40 – BACKWASH EQUALIZATION SYSTEM

A. Backwash equalization storage tank level shall be monitored by ultrasonic level transducer ***40-LE/LIT-001***

B. Status of backwash equalization storage tank entry hatch shall be monitored by limit switch ***40-ZS-001***

C. Backwash tank drain flow rate to the sewer system shall be monitored by flow meter ***40-FE/FIT-001***

2.6 PROCESS 50 – CHEMICAL FEED SYSTEMS

A. General

1. The level of all chemical storage tanks shall be monitored using the ultrasonic level transducers shown on the drawings (50-LIT-01 through 50-LIT-04). When any tank level reaches the high-high level setpoint, the SCADA system shall initiate a contact closure to illuminate the high tank level alarm at the chemical fill station.

2. All chemical metering pumps shall include PID controllers and be flow paced. Some metering pumps will also include a compound loop control mode where described below. The compound loop control mode shall be user selectable. When disabled, the control mode shall revert to flow paced.

3. The start/stop, speed, run, and fail signals from all chemical metering pumps shall be monitored at the SCADA workstation and HMI.

4. The metering pump skids are equipped with duty and standby metering pumps. Only one metering pump will be operated at a time. The duty pump shall be selected at the local H-O-A control panel located at the skid.

B. Sodium Hydroxide Feed System

1. The sodium hydroxide metering pumps ***50-PMP-011*** and ***50-PMP-012*** shall be flow paced based on the filtered water flow rate reported by the filter control system.

2. Compound loop control, if enabled, shall utilize the pH measured at the finished water sampling station ***50-AIT-012A*** to trim the chemical dosage rate.

3. There are redundant pH sensors installed at the finished water sampling station (***50-AIT-012A and 50-AIT-012B)***. ***50-AIT-012A*** will be used for control feedback. If the difference in readings between the two sensor exceeds an operator adjustable value, initially set at 0.25 units, an alarm will be generated and the operator notified.

C. Sodium Hypochlorite Feed System

1. The sodium hypochlorite metering pumps ***50-PMP-021*** and ***50-PMP-022*** shall be flow paced based on the flow measured by the well pump flow meter ***10-FE/FIT-001***

2. Compound loop control, if enabled, shall utilize the free chlorine measured at the finished water sampling station ***50-AIT-001*** to trim the chemical dosage rate.

D. Ferric Chloride Feed System

1. The ferric chloride metering pumps ***50-PMP-031*** and ***50-PMP-032*** shall be flow paced based on the filtered water flow rate reported by the filter control system.

2. A pump fail signal form the ferric chloride system shall force a treatment plant shut down.

3. The ferric chloride metering pump will be equipped with integral flow measurement or a separate flow indicator. The failure of the metering pump to generate measurable flow shall be tied to a SCADA system alarm that will shut the treatment plant down.

E. Sulfuric Acid Feed System

1. The sulfuric acid metering pump ***50-PMP-41*** and ***50-PMP-042*** shall be flow paced based on the filtered water flow rate reported by the filter control system.

2. Compound loop control, if enabled, shall utilize the pH measured at the pre filter sampling station ***50-AIT-002*** to trim the chemical dosage rate.

2.7 ALARMS AND RESPONSES:

A. Following is a list of initial instrument alarm setpoints and responses. The operators shall have the flexibility to adjust all setpoints and responses.

Instrument	Process Setpoint	Alarm	Initial Alarm Setpoint	Initial Response
10-FIT-001 (well flow)		Low	800 gpm	Plant shutdown
		High		
10-PIT-001 (well pressure)	70 psi	Low	25 psi	Plant shutdown
		High	80 psi	Plant shutdown
10-PSHL-001 (well pressure)		Low	25 psi	Plant shutdown
		High	80 psi	Plant shutdown
10-PIT-002 (distribution system pressure)	55 psi (in Pressure Mode)	Low	45 psi	Start pressure in Pressure Mode
		High	65 psi	Stop pressure in Flow Mode
		High-High	70 psi	Plant shutdown
10-LIT-001 (well water level)		Low	TBD	Alarm
30-FIT-001 (bypass flow)	Manually Adjusted	Low	0 gpm	Alarm
		High	1,000 gpm	Plant shutdown
30-FIT-011 (backwash flow)	Manually Adjusted	Low	2,000 gpm	Alarm
		High	2500 gpm	Alarm

40-ZS-001 (tank intrusion switch)				Alarm
40-LIT-001 (backwash tank level)		High	14 feet	Alarm if filter system calls for backwash
		High-high	16 feet	Plant shutdown if filter system calls for backwash
40-FIT-001 (backwash tank drain)		High	120 gpm	Alarm
50-LIT-021, -031, and -041 (chemical tank elevels)		Low-low	1 feet	Plant shutdown
		Low	2 feet	Alarm
		High	6 feet	Alarm, activate local annunciator
50-PMP-011 through -042 (chemical feed pumps)		Pump failure alarm		Plant shutdown
50-PMP-031 / -032 (ferric chloride pumps)		Failure to detect flow		Plant shutdown
50-AIT-001 (pre-filter chlorine)		Low-low		
		Low	0.5 mg/L	Alarm
		High	1.5 mg/L	Alarm
		High-high		

50-AIT-002 (pre-filter pH)	7.7	Low-low	7.0	Plant shutdown
		Low	7.3	Alarm
		High	7.9	Alarm
		High-high	8.2	Plant shutdown
50-AIT-011 (finished water chlorine)	1 mg/L	Low-low	0.3 mg/L	Plant shutdown
		Low	0.5 mg/L	Alarm
		High	1.5 mg/L	Alarm
		High-high	2 mg/L	Plant shutdown
50-AIT-012A/B (finished water pH)	7.7	Low-low	7.0	Plant shutdown
		Low	7.3	Alarm
		High	7.9	Alarm
		High-high	8.2	Plant shutdown
		Difference between A and B	0.25	Alarm
50-AIT-013 (finished water turbidity)		Low-low	0 NTU	Plant shutdown
		Low	0.1 NTU	Alarm
		High	0.5 NTU	Alarm
		High-high	1.0 NTU	Plant shutdown

END SECTION

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SECTION 40 97 15

PRESSURE GAUGES

PART 1 GENERAL

1.1 WORK INCLUDED

A. All analog dial-type pressure gauges and accessories to be furnished and installed as indicated in the Contract Documents.

B. All labor, materials, equipment and incidentals necessary and required for their completion.

1.2 RELATED WORK

A. Section 40 05 23 – Valves and Appurtenances

B. Section 40 05 00 - Pipe and Fittings

1.3 QUALITY ASSURANCE

A. Except as modified or supplemented herein, all gauges shall conform to the requirements of ANSI B40.1.

B. Pressure gauges shall be the standard product of a single manufacturer regularly engaged in the production of gauges of the types specified herein.

1.4 SUBMITTALS

A. As specified in Section 01 33 00 – Submittals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Pressure gauges shall be as manufactured by Ashcroft, Weksler, or Engineer approved equivalent.

B. MATERIALS

1. Materials of construction shall be as follows:

Function	Material
Bourdon tube	Phosphor bronze
Movement	Stainless steel
Ring	Stainless steel or phenolic
Window	Acrylic plastic or shatterproof glass

2.2 FABRICATION AND MANUFACTURE

A. Unless otherwise specified, gauges shall be indicating dial type with C-type bourdon tube, rotary geared movement, phenolic open front turret case, and adjustable pointer.

B. The dial shall be 4-1/2 inch size with white background and black markings. The units of measurement shall be indicated on the dial face. Subdivisions of the scale shall conform to the requirements of the governing standard. Pointer travel shall be not less than 200 degrees nor more than 270 degrees of arc. Range shall be such that the normal operating reading shall be near the midpoint of the range.

C. All stem mounted gauges shall be provided with 1/2 inch minimum NPT connections.

D. Unless otherwise specified, gauge accuracy shall be ANSI Grade A or better. Overall accuracy for diaphragm seal protected and liquid filled gauges shall be ANSI Grade B or better.

2.3 ACCESSORIES

A. Isolation Valves

1. Unless otherwise indicated on the drawings, each gauge shall be provided with a threaded end ball type shutoff valve (gauge cock). Valves shall be of brass or bronze construction, two piece end entry body, bronze or brass ball, teflon or Viton stem seal. Valves shall be rated at not less than 250 psi and shall be drip-tight in all directions.

B. Snubbers

1. Each pressure gauge shall be provided with a pressure snubber, and shall be of a size and pressure range compatible with the gauge served.

2. Pressure snubbers shall be Operating and Maintenance Specialties "Ray Snubbers", Ashcroft "Pulsation Dampers," or Engineer approved equivalent.

C. Diaphragm Seals

1. A diaphragm seal shall be provided on all gauges as indicated in the schedule.

2. Diaphragm seals shall be AISI Type 316 stainless steel diaphragm, zinc or cadmium plated carbon steel upper housing, and bronze lower housing. The upper housing shall be contoured to fit and provide a seat and seal for the diaphragm and shall be designed to permit removal of the gauge with the system under pressure. The lower housing shall be provided with a tapped and plugged 1/4 inch NPT flushing connection. Diaphragm seals shall be suitable for raw sewage.

3. Each diaphragm seal and the gauge served shall be factory assembled, filled with glycerin or silicon oil and calibrated as a unit.

PART 3 EXECUTION

3.1 INSTALLATION

A. Gauges shall be installed at the locations indicated on the Plans.

B. All gauges, snubber and diaphragm seals shall be installed in the vertical upright position. Teflon thread tape or teflon thread sealer, shall be used in the assembly of threaded connections. All connections shall be free from leaks.

C. Lines shall be purged of trapped air at gauge locations prior to installation of the gauge or diaphragm seal.

END SECTION

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SECTION 43 21 52

VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, testing, and installation of oil lubricated vertical turbine pumps in wells for clear liquid service.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 00 – Piping and Fittings

C. Section 33 13 00 – Disinfection of Water System

1.3 REFERENCES

A. American Water Works Association (AWWA)

B. Hydraulic Institute (HI)

C. American Society for Testing and Materials (ASTM)

D. American National Standards Institute (ASNSI)

E. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 - Submittals.

B. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, etc.), and grade or type. Show linings and coatings. Include total pump weight.

C. Submit pump manufacturer ISO-9001 certification.

D. Show shaft diameter and bearing spacing. Submit calculations showing shaft critical frequency and determination of bearing spacings.

E. Submit catalog pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show required submergence and NPSH.

F. 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 the sample form in Section 6 of the ASME PTC 8.2.

G. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, 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.

H. Submit report on results of reed critical frequency finite element analysis or factory resonance test.

I. Submit motor data.

J. Submit manufacturer's installation instructions.

K. Submit Operations and Maintenance Manual

1.5 QUALITY ASSURANCE

A. All components must be supplied by the same pump manufacturer including bowls, impellers, column, shafting, heads, coupling, sleeves, seals, and motors. The pump manufacturer shall have complete unit responsibility for meeting the requirements of this specification.

B. Pump manufacturer shall have ISO-9001 certification. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.

C. Except as modified or supplemented herein, all vertical turbine pumps shall conform to the applicable requirements of ANSI/AWWA E101 and the Hydraulic Institute Standards.

D. Welding shall comply with the ASME Boiler and Pressure Vessel code, Section IX. Provide full penetration welds.

E. All materials and coatings in contact with potable water shall be ANSI/NSF-61 certified and comply with California AB 1953.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Pumps and appurtenances shall be manufactured by Trillium, Flowserve, Pentair, or equal.

2.2 DESIGN REQUIREMENTS

A. The pump curve shall be continuously rising and free from dips and valleys from 70 percent of the design flow to the shutoff head.

B. For design and rating purposes, the water to be pumped shall be assumed to be clear liquid having a mean temperature of 70 degrees Fahrenheit.

C. Pump performance shall be stable and free from damaging cavitation, vibration, and noise within the operating range.

D. At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.2.

E. Pump test acceptance grade shall be 1B unless otherwise noted.

2.3 SERVICE CONDITIONS

A.

Service	Well Pump
Tag Numbers	10-PMP-01
Location	Indoors
Well Casing Diameter	18 inch
Pump Discharge Elevation	102 ft
Total Well Depth	617 ft
Well Screen Depth	285 ft to 565 ft below ground surface
Estimated Depth to Static Water Level	90 ft
Estimated Depth to Pumping Water Level	225 ft
Bowl Depth Required	270 ft
Design Flow (GPM)	3,000
Design TDH	420 ft
Minimum Flow (when using VFD)	1,000 gpm
Minimum TDH (when using VFD)	430 ft

Maximum RPM at Design Conditions	1770
Minimum Bowl Efficiency at Design Flow/TDH	84%
Maximum Motor HP	450
Motor Type (Solid/Hollow Shaft)	Hollow Shaft
Variable Speed	Yes
Pump Lubrication (Water/Oil)	Oil Lubricated
Column Pipe (Flanged/Threaded)	Threaded
Discharge Head (Cast/Fabricated)	Fabricated
Seal (Mechanical/Packing/Oil Lubricated)	Oil Lubricated

Secondary Design Conditions		
Flow	**Total Head**	**Minimum Efficiency (%)**
2,500 gpm	458 ft	79%
2,000 gpm	480 ft	71%
1,500 gpm	507 ft	59%

2.4 MATERIALS OF CONSTRUCTION

A. Materials of construction shall be as follows:

Component	**Material**

Pump Bowls	Cast Iron (ASTM A48 c130 - Enamel Lined)
Impellers	952 Bronze – (ASTM B584 Alloy 952)
Bowl Assembly Shaft	416 SS - (ASTM A582 Type 416)
Bowl Bearings	Bronze - (ASTM B505 Alloy 932)
Collets	Steel - (ASTM A108 Gr 1215)
Wetted Bolting	304 SS – (ASTM F593 Gr CW1)
Bowl Wear Rings	Bronze - (ASTM B148 Alloy 954)
Impeller Wear Rings	Bronze - (ASTM B505 Alloy 952)
Strainer	Galvanized steel
Column Pipe	ASTM A53 Gr. B no less than STD weight
Line Shaft and Couplings	416 SS – (ASTM A582)
Line Shaft and Couplings (Oil Lubricated)	416 SS – (ASTM A582) or carbon steel (ASTM A108 Gr 1045)
Line Shaft Sleeves	304 Stainless Steel
Line Shaft Bearings (Water Lubricated)	Styrene Butadiene Rubber (SBR)
Line Shaft Bearings (Oil Lubricated)	ASTM B505 Bronze
Bearing Retainers	Ductile Iron – (ASTM A536Gr 60-40-18)
Enclosing Tube	ASTM A53 Sch 80
Discharge Head (Fabricated)	Fabricated Steel - (A516-Gr 70 plt, A105 flg, A53-Gr B pipe)
Sole Plate	Fabricated Steel (A516-Gr 70 plt)

2.5 BOWL ASSEMBLY

A. The pump bowls shall be constructed of the material as listed under the subsection “materials of construction”. The water passages on bowl sizes 4” through 19” shall be lined with porcelain enamel and larger sizes shall be fusion bonded epoxy lined to reduce friction losses. The waterways and diffusion vanes shall be smooth and free from nodules, bumps & dips and shall be cast of high quality free of blow holes, sand holes and other detrimental defects. The bowls shall be accurately machined and fitted with a suction case or suction bell as shown on the drawings. The bearings shall be sleeve type of the material listed in the subsection “materials of construction” and are to be lubricated by the product being pumped. The bearings are to be located above and below each impeller. The suction bearing shall be permanently packed with food grade grease, and shall have a length not less than 2 times the shaft diameter. The bowls are to be of threaded connection for sizes up to & including 8” diameter, and are to be flanged with machined rabbet fit connections for sizes larger than 8” diameter. When applicable, the bowl bolting material shall be as listed in the subsection “materials of construction”.

B. Fit all bowls & impellers with renewable wear ring(s) or design them to allow installation of renewable wear rings in the future. The wear rings shall be constructed of material as outlined in the subsection “materials of construction”. The bowl & impeller wear ring shall have a minimum Brinnell hardness difference of 50BHN. Wear ring clearances shall not exceed 0.002 – inch clearance per inch of diameter.

C. The impellers shall be cast in one piece of the enclosed type, and constructed of the material listed in the subsection “materials of construction”. The impellers shall be statically and dynamically balanced. Unless otherwise indicated, if the bowl diameter is smaller than 22” diameter the impeller shall be securely fastened to the shaft with taper split bushings (collets) of the material listed in the subsection “materials of construction”. Impellers with bowl diameters larger than 22” shall be double keyed. The impeller shafting shall conform to the material listed in the subsection “materials of construction”. Impellers shall be adjusted vertically by external means and shall have sufficient axial clearance for reliable service in accordance with the specified operating conditions.

2.6 COLUMN ASSEMBLY

A. Outer column pipe diameters 4” thru 14” shall be in interchangeable sections not over 10’ in length for 1800 RPM and maximum 5’ lengths for pumps running at 3,600 RPM. The top and bottom sections of column pipe for product lubricated pumps shall not exceed 5’.

B. Where threaded column pipe is identified in “Service Conditions”, the ends of each section shall be faced parallel and machined with 8 straight threads per inch permitting the ends to butt and insuring alignment when connected by standard mill steel couplings. The weight of the column pipe shall be no less than that stated in ANSI/AWWA Specification E101, Section 5.1 “Standard Specifications for Discharge Column Pipe”. The column size shall be such that friction loss will not exceed 5’ per

100', based on the design capacity of the pump or as listed under the subsection "service conditions".

C. Where flanged column pipe is identified in "Service Conditions", the column pipe shall be flanged with rabbeted fits to ensure proper alignment. The weight of the column pipe shall be no less than that stated in ANSI/AWWA Specification E101. The column size shall be such that friction loss will not exceed 5' per 100', based on the rated capacity of the pump. Flange bolting shall be of the materials as listed in the subsection "materials of construction".

D. The column line shaft shall be turned and ground and manufactured of the material listed in the subsection "materials of construction". They shall be furnished in interchangeable sections not over 10 feet in length. The butting faces shall be machined square to the axis of the shaft with maximum permissible misalignment of the thread axis with the shaft axis 0.002" in 6". The size of the shaft shall be no less than that determined by ANSI/AWWA-E101 Specifications, Section 5.5 and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls. Maximum run out shall not exceed 0.005" in 10 feet. The line shafts shall be provided with sleeves at the location of each line shaft bearing.

E. For water lubricated pumps, the line shaft bearings shall be sleeve type provided of the material listed in the subsection "materials of construction". Line shaft bearing spacing shall be such that shaft first critical frequency shall be safely above or below the operating frequency.

F. For oil lubricated pumps, the line shaft bearings shall be sleeve type, internally spiral grooved to allow lubricant to flow through, and threaded externally to act as enclosing tube connectors .The enclosing tube shall be of ASTM A53 Schedule 80 with the ends machined square and parallel, threaded internally to receive the line shaft bearings. Maximum tube tread run out in 5' length shall not exceed 0.005". Bearing spacing shall not exceed 5'.

G. Threaded shaft couplings are to be supplied for shafts less than 2-3/4" diameter and shall be sized per ANSI/AWWA E101 section A-4.1.4. They shall utilize left-hand threads to tighten during operation.

H. Bearing retainers shall be of the drop-in type, held in place by compression of the butted ends of the column pipe. The bearing retainers are to be on the material listed in the subsection "materials of construction".

2.7 DISCHARGE HEAD

A. Fabricated discharge heads shall be fabricated of carbon steel materials using ASTM A181 flanges, ASTM A53 Grade B body pipe and ASTM A516 steel plate. Discharge head design shall be capable of containing maximum pressure developed by pump plus suction pressure. The discharge flange shall be 150# ANSI flat face with bolt holes straddling the vertical centerline. A 1/2" NPT pressure gauge connection shall be supplied on the top centerline of the discharge outlet. Where the head is installed on a barrel, a ¾" NPT barrel vent tap shall provided to vent air from the top of the

barrel. The top of the discharge head shall be machined to accept a standard NEMA P base driver and have a diameter equal to the driver base diameter (BD).

B. Cast discharge heads shall be of close grained, cast iron, ASTM A48 class 30, free of sand holes and other defects, accurately machined with an above surface discharge. The discharge flange shall be machined and drilled to ANSI standards for 125# rating and is to be flat faced. The top of the discharge head shall be machined to accurately locate a standard NEMA P base driver and have a diameter equal to the driver base diameter (BD). For barrel pumps, the base flange shall be machined, drilled & gasketed to provide a pressure containing seal to the top of the suction barrel. Cast discharge heads will not be accepted for pumps operated on VFDs.

C. All couplings and other moving or rotating parts shall be covered on all sides by an OSHA approved coupling guard. Coupling guards shall be fabricated from 16 USS gage or thicker galvanized or aluminum-clad steel or from 1/2 inch mesh expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard.

D. The pump shall be furnished with a Stainless Steel nameplate securely mounted to the discharge head. At a minimum it shall contain information providing (design flow, design TDH, HP, RPM, bowl model number, number of stages, manufacturer serial number, pump type & impeller setting dimension).

E. For pumps with a solid shaft driver, a rigid Flanged Adjustable “Spacer” type Coupling (FASC) shall be provided to couple the motor shaft to the pump shaft. The spacer shall be of sufficient length to allow the mechanical seal to be removed without disturbing the motor. This coupling shall allow for the vertical adjustment of the shaft mounted impellers.

F. For pumps with a hollow shaft driver, the headshaft shall be coupled to the top lineshaft beneath the motor to facilitate ease of assembly and maintenance.

G. For oil lubricated pumps, the head shall be equipped with an aluminum four quart lockable oil reservoir fitted with and automatic solenoid valve and sight drip oiler.

H. For oil lubricated pumps, the discharge head shall be equipped with a tube tensioning device to apply and maintain proper tension to the shaft enclosing tube. This device shall consist of a cast iron tube tension plate and bronze combination tube tension nut and bearing. Tension shall be applied to the tube through internal threads in the top tube. After proper tensioning, the nut shall be locked into position with a steel cap screw. Sealing between the plate & discharge head and the plate and shaft enclosing tube shall be accomplished by means of “O” rings. A ¾” tap shall be provided through the discharge head body to allow pre-lubrication of the line shaft bearings prior to pump starting.

2.8 SEAL

A. Where a mechanical seal is specified under “Service Conditions”, the discharge head shall be fitted with a mechanical seal. The seal shall be of the cartridge type, sleeve

mounted, easily replaceable and have its face continuously flushed with the product being pumped. The seal shall be equivalent to the Chesterton 155 or John Crane 5611.

B. Where packing is specified under “Service Conditions”, the standard cast iron stuffing box shall be rated for 150# discharge pressure and shall be fitted with graphite acrylic packing and have either a greased lantern ring or grease chamber below the first packing ring. The throttle bearing shall be of bronze ASTM B505 alloy C93200. The packing gland shall be of stainless steel ASTM A743 GR CF-8M with stainless steel studs and with brass or stainless steel adjusting nuts. Sealing between the stuffing box and the discharge head shall be accomplished by means of an “O” ring. Packing box is to be secured in place with a minimum of eight cap screws. The packing box shall utilize a split type packing gland to allow ease of packing removal & installation.

2.9 MOTOR

A. Pump shall be driven by a vertical holloshaft or solid shaft type electric motor as specified under “Service Conditions”.

B. Motors shall be suitable for continuous operation on a three-phase 60-hetz system rated for 460 volts.

C. Motors with a nameplate rating of 5 HP and above shall be “premium efficiency” units as set forth in ANSI/IEEE 112, Method B.

D. Motors smaller than 50 HP installed outdoors shall be totally enclosed, fan cooled (TEFC). Motors larger than 50 HP which will be installed outdoors shall be Weather Protected Type I. Except as otherwise indicated, all motors which will be installed indoors shall be open drip-proof with 2 cycles of solid baked epoxy vacuum impregnation or Weather Protected Type I or II.

E. Motors for variable frequency drives (VFD) shall be specifically rated for inverter duty and shall be severe duty NEMA MG 1 design A or B, high efficiency, with NEMA MG 1 Class F insulation. Winding temperature rise shall be limited to Class B rise when operating over the specified speed range. Motor insulation shall be designed to meet NEMA MG 1, Part 31 (1600-volt peak at a minimum of 0.1 microsecond rise time). Motors shall conform to IEEE 841. All internal surfaces shall be coated with epoxy paint.

F. Inverter duty motors shall be equipped with shaft-grounding with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.

G. Motor winding PTC thermistors with controller shall be provided.

H. 120 volt space heaters shall be provided on all 25 HP and larger motors.

I. Provide Class F insulation with Class B rise requirements. Motor shall have a 1.15 SF (1.0 for inverter service) and shall be non-overloading over the complete pump curve.

J. The driver will house the pump thrust bearing that is to be rated for 125% of the maximum down thrust of the entire pump. The driver bearing shall also be capable of

handling a momentary up thrust force equivalent to a maximum of 30% of it's down thrust rating. Motor shall be fitted with a non reverse ratchet. The motor thrust bearings shall be oil-lubricated with accessible drain and fill plugs on the oil reservoir. The sight gauge assembly on the oil reservoir shall be easily serviceable and removable from the outside without disassembly of any part of the motor. The lower guide bearing shall be grease lubricated. The bearings shall have an L-10 life rating of at least 40,000 hours at the operating down-thrust presented by the pump assembly.

K. Motors shall be fabricated, assembled, and tested in accordance with the most current applicable standards as defined by ANSI, IEEE, NEMA, and AFBMA. Motors shall comply with ANSI/NEMA MG 1. Motors shall be labeled as being approved by the Underwriters Laboratories (UL).

L. The motor conduit box shall be of fabricated steel or cast iron construction, shall be diagonally split and capable of rotation in 90 degree increments. Boxes shall be provided with a grounding terminal.

M. Motors over 25 HP shall have short commercial tests performed which include: no load current, locked rotor current, winding resistance, high potential, and vibration and bearing inspection.

N. Hollow shaft motors on pumps specified with mechanical seals shall incorporate a steady-bushing at the base of the motor.

2.10 PUMP ANCHORAGE

A. Stainless steel anchor bolts shall be sized by the pump manufacturer. Pump anchorages shall be designed for earthquake effects based on the latest edition of the California Building Code and the project geotechnical report. Loads shall be applied simultaneously with normal pump operation forces, as well as for maximum reactions due to other pump design events.

2.11 FACTORY COATING

A. The bowl assembly OD and discharge head ID shall be factory painted with a NSF 61 approved two part epoxy coating, such as Carboguard 891. The coating shall be applied in two coats of 4-6 mils DFT, with a final dry film thickness no less than 10-12 mils. Prior to coating, all surfaces are to receive a commercial blast meeting SSPC-SP10 and shall be primed. The ID and OD of column pipe shall also be coated except in the case of well pumps.

B. Exterior surfaces of the discharge head and sole plate, as applicable, shall be coated by the Contractor in the field in accordance with Section 09 90 00.

2.12 FACTORY REED CRITICAL FREQUENCY ANALYSIS

A. The pumping unit shall be deigned to safely operate free of reed resonant frequency. For VFD-driven pumps and/or pumps with a fabricated discharge head perform a natural frequency analysis of the head, motor stand (if applicable), and electric motor shall be performed by a licensed Professional Engineer using finite element analysis software. A report shall be provided with the submittal showing that the natural

frequencies and mode shapes of the pump and motor have been considered in the design of the discharge head, and certify that the critical frequency is at least 20% above or below the operating range.

2.13 FACTORY PERFORMANCE TESTING

A. Each bowl assembly shall be non-witness tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head or point of discontinuity, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. If the pump fails to operate properly or fails to meet the specified conditions or requirements during shop testing, the pump manufacturer shall modify the pumping unit and perform additional tests. The pump manufacturer shall submit complete pump test reports, including test arrangement, instrumentation calibration data, test procedures, & test data in curve format.

B. Performance test acceptance grade shall be 1B in accordance with ANSI/HI 14.6.

C. All fabricated or cast pressure-containing pump components shall be hydrostatically testing in accordance with ANSI/HI 14.6.

PART 3 EXECUTION

3.1 INSTALLATION

A. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and Inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of ENGINEER.

B. The manufacturer’s representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

C. All costs of these services shall be included in the contract price for the number of days and round trips to the site as required.

3.2 FIELD QUALITY CONTROL

A. Bump motor to ensure proper rotational direction before coupling the motor to the pump.

B. Perform field vibration measurements during normal operation. Vibration levels shall be within HI limits. Repair or replace pumps not meeting the HI vibration limits.

C. Collect flow and discharge pressure data from at least three different flow rates, including the design flow rate. Compare the data with the factory performance curve and notify the Engineer if the data varies by more than 5%.

END SECTION

SECTION 43 41 11

BOLTED STEEL

WATER STORAGE TANK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Design, fabrication and erection of a Type-6 embedded bolted steel water storage tank in accordance with AWWA D103, including Section 12 for seismic design.

B. Steel tank and appurtenances including: pipe connections, manways, ladders, hatches, vents, water ultrasonic level transmitter mounting nozzle, and other appurtenances specified and as indicated on the Plans.

C. Inlet & outlet piping nozzles as specified in this Section and in the Plans.

D. Other work as noted on the Plans

1.2 RELATED SECTIONS

A. Section 03 30 10 - Concrete Site Work

B. Section 31 23 00 – Earthwork

C. Section 32 11 23 – Aggregate Base

D. Section 40 05 00 - Pipe and Fittings

E. Section 40 05 23 - Valves and Appurtenances

F. Division 26 - Electrical

1.3 DESIGN INFORMATION

A. The tank dimensions (feet) and capacity (in millions of U.S. gallons – MG) are as follows:

Type of Tank	Useable Capacity (Gal)	Inside Diameter (Feet)	Overflow Height (feet)
Type-6 foundation	54,400	21	As necessary to provide useable storage capacity

Useable capacity not including volume of cast in place concrete cone bottom.

B. Provide a supported roof with a slope of 1 inch in 12 inches.

C. Design roof live load: 20 psf

D. Design wind velocity: 110 mph

E. Lowest one-day mean ambient temperature: + 32F.
Highest one-day mean ambient temperature: + 95F.

F. Comply with AWWA D103. Alternative rules and design stresses in Section 14 may be utilized.

G. Bottom shall be as shown on the plans.

1.4 SEISMIC DESIGN

A. Tank and foundation design shall be in accordance with AWWA D103, Section 12, and shall also conform to the requirements of the California building code.

B. Design based on the following criteria

Parameter	Value	Units
Latitude	37.52991	
Longitude	-120.88110	
Spectral Response - 0.2 sec (Ss)	0.676	g
Spectral Response - 1.0 sec (S1)	0.267	g
Soil Site Class	D	
Site Coefficient Factors (Fa)	1.259	
Site Coefficient Factors (Fv)	2.066	
Adjusted Spectral response (SMS)	0.851	g
Adjusted Spectral response (SM1)	0.552	g
Design Spectral Response (SDS)	0.568	g
Design Spectral Response (SD1)	0.368	g
Seismic Use Group	II	
Importance Factors (I)	1.25	

Seismic Design Category (SDC)	D	
Response Modification Coefficient (R)	3	
Long-Period Transition Period (TL	12	sec
Redundancy Factor (ρ)	1.3	

1.5 REFERENCES

A. AWWA D-103 Standards of the American Water Works Association

B. NFPA-22 Standard for Water Tanks for Private Fire Protection

C. API 12B American Petroleum Institute Standard for Bolted Tanks

D. California Building Code

1.6 SUBMITTALS

A. Submit in conformance with Section 01 33 00 – Submittals.

B. Provide complete design calculations for tank and steel setting ring, and detailed drawings signed and stamped by a Civil or Structural Engineer licensed to practice in California.

C. Submit detailed tank drawings and supplemental information including the following:

1. Dimensional drawings, indicating size and thickness of all members. Shop drawings shall include manufacturer's drawings showing the dimensions of the tank, indicating the height to lower and upper capacity levels, the thickness of all important plates, and all principal members, accompanied by data and stress sheets together with welding or bolting data for each type of joint, with computations in sufficient detail to enable the stresses to be readily checked.

2. Accessory list with fabrication and attachment details.

3. Sufficient information on the proposed coating products and application procedures so that compliance with these specifications may be determined.

   a. Provide coating materials list which indicates the manufacturer and the coating number, keyed to the coating schedule herein.

4. Submit Manufacturer’s standard color samples.

1.7 QUALIFICATION/EXPERIENCE

A. The manufacturer shall be quality certified, having an active API-Q1 and an ISO 9001 registration.

1.8 WARRANTY

A. The reservoir shall be deemed accepted when the reservoir has been proved free from leaks and other defects to the satisfaction of the Owner and the Notice of Completion has been filed for Record. The acceptance by the Owner of the completed work as herein specified is subject to the Contractor's warranty for the completed work against defects in materials or workmanship furnished by the Contractor for a period of one (1) year from the date of acceptance and recording of the Notice of Completion.

B. Warranty Inspection - The Owner shall conduct the warranty inspection during the eleventh month following acceptance, of all work required by this section. All defective work shall be repaired, by the Contractor, in accordance with the manufacturer's recommendation and to the satisfaction of the Owner in order to bring the defective areas up to the quality level of the original work required by this specification.

PART 2 PRODUCTS

2.1 WATER STORAGE TANK

A. Foundation

1. Concrete shall comply with Section 03 30 10 –Concrete Site Work.

B. Bolted Tank Structure

1. The materials, design, fabrication, and erection of the bolted steel tank shall conform to the American Water Works Association Standard for Bolted Tanks D-103-97.

2. Steel

a. Steel Sheets

1) Steel sheets shall conform to ASTM A570 Grade 33 with minimum yield strength of 33,000 psi.

2) Minimum thickness shall be 12 gauge (0.0972 in.)

b. Steel Plates

1) Steel Plates shall conform to or the requirements of ASTM A36 with a minimum yield strength of 36,000 psi.

c. Rolled Structural Shapes

1) Rolled structural shapes shall conform to ASTM A36.

3. Bolts/Nuts/Washers

a. Galvanized Bolts

1) Galvanized bolts, nuts, washers used in tank joints shall be minimum ½" bolt diameter and shall meet the requirements of API 12B, Appendix A, except that bolt heads and nuts may be other than square at the option of the tank manufacturer.

b. Poly-capped Bolts

1) Poly-capped bolt heads shall be used for additional corrosion protection.

c. Other Bolts

1) Other bolts shall conform to ASTM A307.

4. Gaskets

a. All bolted connections shall incorporate an EPDM prefabricated gasket with a minimum width of 1-3/4".

b. A single piece double punched gasket shall be used at vertical seams which require two vertical rows of punching.

c. Field caulking will be allowed when joining a discontinuous gasket section and at certain joint connections.

d. Neoprene backed steel washers shall be provided at all bolts in contact with the stored liquid.

2.2 ACCESSORIES

A. Location of accessories shall be as indicated on the Plans, as specified below and as determined by the Owner.

B. Inlet and Outlet Connections: Inlet, outlet, and overflow connections shall conform to the sizes and locations indicated on the Plans

C. Provide other pipe connections as shown on the drawings. All connections except for level transmitter shall include flexible connections as shown in the drawings.

D. Flush Cleanout Door: The flush cleanout door shall measure 24" x 46" and be located as shown on the Plans

E. Shell Manway: The shell manway shall have a 24" opening complete with hinged cover, and shall be located as shown on the Plans.

1. Manways shall have provisions for locking.

F. Ladders:

1. Conform to applicable local, state and federal regulations.

2. Provide an outside ladder. The outside ladder shall be attached securely to the tank. Ladders shall be fabricated in accordance with safety requirements of Local Building Codes and the State of California, Construction Safety Orders and the General Industrial Safety Orders. All joints shall be welded, except where indicated to be bolted, and all welds shall be ground and finished smooth and conform to API Standards. The tank ladder shall be provided with a "Saf-T-Climb" meeting OSHA requirements, as manufactured by North Consumer Products or Engineer approved equivalent, and a lockable ladder gate.

3. Provide one (1) safety climb belt and sleeve set.

G. Roof guardrails shall comply with applicable local, state and federal regulations and AWWA D103. Guardrails shall extend around the 24-inch roof hatch and as otherwise shown on the Plans.

H. Provide one (1) 24” square roof hatch in accordance with AWWA D103. Hinges shall be stainless steel.

I. Provide one mushroom type roof vent with removable lid. Vent design shall conceal the screens from horizontal exposure. The vent shall be stainless steel and so designed and constructed as to prevent the entrance of birds, animals, or insects.

1. Vent shall be capable of handling air flow generated by discharging tank contents or filling at 2,500 gpm.

J. Overflow: Provide a weir inlet with overflow pipe to the ground terminating in a 45° elbow fitted with a screen. Weir shall be designed for a flow of 2,500 gpm with a maximum, height of water above crest of 4”.

K. The following nozzles shall be provided on the tank:

1. 12-inch backwash inlet

2. 12-inch future GAC inlet

3. 4-inch drain

4. Overflow

L. Target-type level indicator shall be either custom-fabricated or of standard manufacture meeting the functional requirements stated herein, consisting of a target sliding vertically in a channel over a graduated scale. The target shall be actuated by stainless steel cable attached to a float through a pulley system mounted on top of the tank and shall be equipped with a guide, or guides. All components shall be fabricated of materials that will not corrode in service. The target board shall be marked in feet with figures and markings of such a size to be legible to the naked eye at a distance of 500 feet.

M. Piping connections to tank nozzles shall be provided with flexible joints.

1. Flexible rubber coupling shall be as manufactured by Red Valve Company, Inc., Metraflex Company, or Engineer approved equal.

2.3 COATING

A. All metal plates, supports, members, and miscellaneous parts, except bolts, certain accessories, and appurtenances, shall be factory coated in accordance with the provisions of these specifications.

B. All coatings must meet applicable air regulatory board requirements Interior epoxies must be on the current USEPA or NSF Standard 61 list for potable water coatings and meet all requirements of the State Department of Health Services

C. Field coating, except for touch-up will not be permitted.

D. Surface Preparation

1. Parts shall be grit or shot blasted to SSPC-SP 10 (Near-White Blast Cleaning) to 2-3 mils profile prior to coating.

E. Interior Coating

1. Thermally cured, NSF approved, modified epoxy powder. Coating shall be Trico-Bond EP or Engineer approved equivalent.

a. Coating system shall have 5.0 mils minimum dry film thickness.

b. Color shall be white.

F. Exterior Coating

1. Thermally cured, modified epoxy powder, and acrylic polyurethane.

2. First coating shall be Trico-Bond EP or Engineer approved equivalent.

a. 2.5 mils minimum dry film thickness.

3. Second coat shall be of acrylic polyurethane, 1.5 mil minimum dry film thickness.

a. Color shall be selected by Owner from manufacturer's standard color chart.

4. Top coat shall be clear polyurethane and shall be 1 mils minimum dry film thickness.

G. Curing

1. Baking ovens shall be used after each coat

2. Curing shall be as specified by the coating manufacturer

H. Touch up material

1. Touch-up paint with manufacturer's instructions.

a. Provide the Owner with a minimum of 1 gallon, in unopened containers, for each type of coating.

PART 3 EXECUTION

3.1 FABRICATION

A. Shop fabrication shall be in accordance with AWWA D103, Section 7.

3.2 DELIVERY, STORAGE AND HANDLING

A. All plates, supports, members, and miscellaneous parts shall be packaged for shipment in such a manner to prevent abrasion or scratching of the finish coating.

3.3 ERECTION

A. Erection shall be performed in accordance with the provisions of AWWA D103, Section 8.

1. Particular care shall be exercised in handling and bolting of the tank plates, supports, and members to avoid abrasion or scratching of the coating.

2. Erection shall be in accordance with the tank manufacturer's instructions.

3. Touch-up coating shall be done in accordance with the tank manufacturer's recommendations where and as directed.

3.4 COATING SYSTEM INSPECTION

A. Thickness of coatings shall be checked with a non-destructive, magnetic type thickness gauge. Coating integrity of all interior coated surfaces shall be tested with an approved holiday detection device. Non-destructive holiday detectors shall not exceed 67 volts nor shall destructive holiday detectors exceed the voltage recommended by the manufacturer of the coating system. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and re-tested. No pinholes or other irregularities will be permitted in the final coating. Holiday detection devices shall be operated in the presence of the Engineer.

1. For thicknesses between 10 and 20 mils (0.25mm and 0.50mm) a non-sudsing type wetting agent such as Kodak Photo-Flo, shall be added to the water prior to wetting the detector sponge.

B. In cases of dispute concerning film thickness, measurements made with instruments shown to be in calibration with the National Bureau of Standards calibration plates shall predominate.

C. Inspection Devices - Until final acceptance of coating and painting, the Contractor shall furnish and make available to the Owner's representative inspection devices in good working condition for detection of holidays and measurement of dry film thickness of coating and paint. The contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dry-film thickness gauge. All inspection devices shall be in good working order.

3.5 DISINFECTING

A. Disinfection of interior surfaces shall be performed in the presence of the Engineer in accordance with all the requirements of applicable regulatory agencies. Prior to disinfecting, the complete interior shall be washed down with clean water and thoroughly flushed. Disinfection shall be accomplished by one of the methods outlined in AWWA C652.

1. Chlorine solution accumulated on the bottom shall be drained to waste

2. Rinsing with clear water after disinfecting is not required.

3.6 FILLING AND HYDROSTATIC TESTING

A. Upon completion of all protective coatings as outlined in the plans and specifications, and after disinfection is satisfactorily completed, the reservoir shall be filled with water. The water required for hydrostatic testing shall be furnished by the Owner.

1. The Owner will provide water for the initial disinfecting of the tank at no cost to the Contractor. The Contractor will be charged for any additional water required because of unsatisfactory bacteriological tests at the Owner's rate for service. The Owner will allow disposal of disinfecting water, if required, via the tank drain at a low rate. Any chlorine residual must be neutralized prior to discharge by treating with an alkaline chemical in accordance with Table B1 in AWWA C652

B. Once the reservoir is completely filled it shall sit for a period of 24 hours. If no leaks are present, the tank has satisfactorily passed the hydrostatic test. If repairs are required, the interior and exterior coatings shall be protected during repairs, coatings shall be touched up as necessary, and the tank shall be retested and disinfected to the satisfaction of the Engineer before the work is accepted.

3.7 VOC TESTING

A. After disinfection and leakage testing have been completed and before the tank is placed into service, water from the tank shall be sampled following 5 days of soaking and tested by the Owner for Volatile Organic Compounds (VOCs) in accordance with EPA Method 502.2.

B. If VOCs exceed drinking water standards established by the California Division of Drinking Water, the Contractor shall take whatever measures are necessary to reduce VOCs to acceptable limits, providing however, that the influent water source does not exceed the drinking water standard. The Contractor shall pay all costs associated with sampling and retesting until VOCs meet drinking water standards.

END SECTION

SECTION 43 41 43

VERTICAL POLYETHYLENE CHEMICAL STORAGE TANKS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, testing, and installation of cross-linked high density vertical polyethylene storage tanks for chemical service including the accessories defined herein where indicated on the drawings or under “Service Conditions”.

B. Tank manufacturer shall design and furnish fittings for seismic anchorage of the tank.

1.2 RELATED WORK

A. Not used

1.3 REFERENCES

A. American Water Works Association (AWWA)

B. American Society for Testing and Materials (ASTM)

C. American National Standards Institute (ASNSI)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the Standard General Conditions and Supplementary Conditions.

B. Submit tank manufacturer's data and dimensions showing locations of all openings, locations of level indicators, seismic support structure and anchoring system details, and location of tank accessories.

C. Submit details on inlet and outlet fittings, manways, flexible connections, vents and level indicators.

D. Submit statement by the manufacturer stating compatibility of the tank materials with the chemicals to be stored.

E. Submit tank pad requirements such as pad and block out sizes.

F. Submit manufacturer’s warranty.

G. Submit unloading procedure and installation manual.

H. Submit operation and maintenance manual.

I. Submit supporting documentation of Manufacturer's certification to NSF/ANSI Standard 61 – Drinking Water System Components for water treatment chemicals. Submit Operations and Maintenance Manual.

J. Submit electrical heat tracing, foam insulation data sheets, and other accessory datasheets as applicable.

1.5 QUALITY ASSURANCE

A. All materials in contact with potable water or chemicals used for potable water treatment shall be ANSI/NSF-61 certified.

B. The tanks shall be warranted for 5 years to be free of defects in materials and workmanship. Warranty shall be prorated over the last three years of the warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tanks and appurtenances shall be high density cross-linked polyethylene tanks manufactured by Poly Processing Company, Assmann Polyethylene Tanks, Snyder Industries or equal.

2.2 GENERAL

A. Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, drains, overflows, and anchoring system. Covered tanks shall be vented, and where indicated under "service conditions", tanks shall be provided with entrance manways, level indicators, electrical heat tracing, spray-on urethane foam insulation, and exterior coating. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, and capacity. Tanks shall meet the requirements of ASTM D1998 unless otherwise indicated

2.3 TANKS

A. Materials: Polyethylene shall be of the cross-linked, high density type meeting or exceeding the following requirements:

Parameter	**ASTM Method**	**Value**
Density, gm/cc	D1505	0.937 to 0.945
Tensile Strenth at yield, psi minimum	D638	2600

Elongation at break, min percent	D638	400
Stress-crack resistance, min hours for F50	D1693	1000
Vicat softening temperature, deg F	D1525	230
Brittleness temperature, deg F, maximum	D746	-180
Flexural modulus, psi	D790	100,000

Resin used in the tank shall be equal to Phillips Chemical Marlex CL-200 or CL-250, PAXON grade 7004 or 7204, or equal, and shall contain a minimum of 0.3 percent ultraviolet stabilizer as recommended by the manufacturer. Where black tanks are indicated, the black resin shall contain 2 percent carbon black blended into the resin.

B. Chemical storage tanks shall be suitable for the service conditions listed under that portion of this specification.

C. Tanks shall be constructed using a rotationally molded fabrication process. Wall thickness of the tank shall be designed by the manufacturer with a hoop stress no greater than 600 psi using 1.5 times the specific gravity indicated. Stress shall be calculated using the Barlow formula.

2.4 TANK FITTINGS

A. Tank fittings shall be of the size and location shown on the drawings.

B. Gasket material shall be compatible with the chemical service.

C. No metals shall be exposed to the tank contents.

D. Any screwed fittings shall use American Standard Pipe Threads. No metals shall be exposed to tank contents.

E. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. All materials shall be compatible with chemical service. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.

F. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.

G. Vents: Each tank must be vented for the material, fill, and withdrawal rates expected. Vents shall comply with OSHA 1910.106(F)(iii)(2)(IV)(9). Vents shall be sized by the tank manufacturer to prevent pressurization of the tank during filling or drawing a vacuum inside the tank during pumping or draining. Vents shall be furnished complete with insect screen.

H. Tanks shall include a 24-inch bolted manway cover at the top of the tank unless otherwise noted on the drawings.

I. On dual wall tanks greater than 1,000 gallons, bottom fitting(s) must be designed to maintain 110% secondary containment integrity. Bottom fitting must include expansion joint designed to accommodate movement of the primary tank.

J. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

K. Where shown on the plans, the tank manufacturer's standard flexible connection fitting shall be furnished. Additional flexible connectors shall be furnished when required by the tank manufacturer's warranty whether shown on the plans or not.

2.5 LEVEL INDICATION

A. All chemical tanks shall include some form of level indication. For all tanks, graduations shall be provided at every 200 gallon interval with 1,000 gallon intervals clearly labeled for bulk storage tanks. Unless otherwise indicated, graduations shall be marked on the tank exterior. The following specific forms of level indication shall be provided where indicated under "service conditions".

B. Float Indication: The level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC sight tube, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be neon orange color for visual ease for onsite operators.

C. Liquid Level Gauges: Liquid level gauges shall be constructed from 1-inch minimum diameter clear PVC tubing. Tubing shall be supported from the tank every 3 feet. Isolation valves shall be installed at both the top and the bottom of the level gauge.

D. Magnetic Flag Type Gauges: Magnetic flag type level indicators shall be externally mounted and consist of a chemically resistant magnetic float, externally mounted float housing, magnetic flag indicator assembly and scale. The indicator housing shall fasten to openings in the side of the tank, with the float assembly the full height of the tank. The level indicators shall have two-colored magnetic flags that flip colors to indicate liquid level. The level indicators shall include a metal scale to provide a

numerical readout of the liquid level in gallons. The level indicators shall be GEMS "SureSite Indicators" or equal.

E. Ultrasonic level indicators and diaphragm level transmitters, where indicated under "service conditions", will be supplied by the Contractor separately from the tank.

2.6 TANK INSULATION

A. Where indicated under "service conditions", tanks shall be provided with factory-applied spray-on foam insulation. Insulation shall be polyurethane foam with a density of 2.5 lb/ft3 with a minimum "R" value of 6.3/in. The foam shall be applied with a nominal thickness of 2" to the external tank surfaces except for the tank bottom.

B. Upon completion of application and curing of the insulation, 2 full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

2.7 HEAT TRACING

A. Heat tracing system for temperature maintenance shall be designed to maintain a desired product temperature, not to exceed 100 degrees F utilizing heating pads/panels. Each system shall include tank heating pads and a temperature controller. The quantity and type of pad shall be determined by the size of the tank, the desired temperature maintenance and environmental conditions. Heating systems, if required, are specified under "Service Conditions" based on the delta-T in degrees Fahrenheit between the product temperature and the minimum ambient temperature. Tanks shall be supplied with the heating panels and a controller installed by the tank manufacturer. Power supply shall be the only field installation required.

B. Pads to operate on 120 vac single phase with a maximum power density of 0.5 watts/sq.inch.

C. Pad heaters must fully comply with Article 427-23 (b) of the National Electric Code.

D. Temperature controller shall be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 150 degrees F.

2.8 RESTRAINT SYSTEM

A. The tanks shall be provided with seismic restraint systems designed by the manufacturer for the following California Building Code seismic design parameters:

Parameter	Value
S_S	0.676g
S_1	0.267g
Site Class	D
Design Category	D
F_a	1.259
F_v	2.066
PGA	0.371g
S_{MS}	0.851g
S_{M1}	0.552g
S_{DS}	0.568g
S_{D1}	0.368g
F_{PGA}	1.321
PGA_M	0.371g
C_{RS}	0.952
C_{R1}	0.951

B. Where indicated under “service conditions”, the tanks shall be provided with wind restraints for the wind speed indicated. Wind restraint shall be designed to restrain an empty tank.

C. Seismic and wind restraint system components likely to be exposed incidentally to the process chemical, shall be fabricated from materials resistant to the process chemical.

2.9 SIGNAGE

A. Each tank shall be clearly marked with hazardous material warning signs conforming to NFPA 704. Each tank shall also have a sign with the word "DANGER" and the name of the chemical stored, printed in large block letters and mounted directly adjacent to the tank outlet and tank inlet. Each entry manway shall be provided with a sign ("DANGER--CONFINED SPACE--HAZARDOUS ATMOSPHERE").

2.10 SERVICE CONDITIONS

A. Sodium Hydroxide Tanks

Chemical Service	25% - 50% Sodium Hydroxide
Double Wall	Yes

Tank Quantity	1
Location	Outdoors under awning
Tank Volume, Min	3,150 gallons
Tank Dia, Nominal	10’-2”
Tank Shell Height, Nominal	10’ – 3”
Wind Exposure	NA
Level Indicator	Liquid Level Float and ultrasonic transducer per plans
Color	White/natural
Insulation	Yes
Heat Tracing	Yes (ΔT=60)
Ambient Temperature	15 – 115 deg. F

B. Sodium Hypochlorite Tank

Chemical Service	12.5% Sodium Hypochlorite
Double Wall	Yes
Tank Quantity	1
Location	Outdoors under awning
Tank Volume, Min	1,550 gallons
Tank Dia, Nominal	8’-0”
Tank Shell Height,	6’ – 11”

Nominal	
Wind Exposure	NA
Level Indicator	Liquid Level Float and ultrasonic transducer per plans
Color	White/natural
Insulation	NA
Heat Tracing	NA
Ambient Temperature	15 – 115 deg. F

C. Ferric Chloride Tank

Chemical Service	39% Ferric Chloride
Double Wall	Yes
Tank Quantity	1
Location	Outdoors under awning
Tank Volume, Min	1,550 gallons
Tank Dia, Nominal	8’-0”
Tank Shell Height, Nominal	6’ – 11”
Wind Exposure	NA
Level Indicator	Liquid Level Float and ultrasonic transducer per plans
Color	White/natural
Insulation	NA

Heat Tracing	NA
Ambient Temperature	15 – 115 deg. F

D. Sulfuric Acid Tank

Chemical Service	93% Sulfuric Acid
Double Wall	Yes
Tank Quantity	1
Location	Outdoors under awning
Tank Volume, Min	1,550 gallons
Tank Dia, Nominal	8’- 0”
Tank Shell Height, Nominal	6’ – 11”
Wind Exposure	NA
Level Indicator	Liquid Level Float and ultrasonic transducer per plans
Color	White/natural
Insulation	NA
Heat Tracing	NA
Ambient Temperature	15 – 115 deg. F

PART 3 EXECUTION

3.1 FACTORY TESTING

A. Material taken from each tank shall be tested for the following in accordance with ASTM D1998:

1. Impact (120 ft-lb minimum)

2. Gel, minimum percent

a. 1/32-inch of inner wall: 65

b. Outer wall: 90

c. Total wall: 70

B. Following fabrication, the tanks, including factory applied inlet and outlet fittings, shall be hydraulically tested with water. The factory test shall compensate for the difference in specific gravity between the test water and chemical stored to simulate actual maximum operating pressures. Test methods may include adding a [2.5 psi] air pad to a filled tank or filling the tank with standpipes, raising the maximum water surface approximately [5 feet] higher than the normal maximum tank level. The test duration shall be 24 hours. Following successful testing, the tank shall be emptied and dried prior to shipment.

C. An affidavit signed by the tank manufacturer shall be furnished indicating that the factory tests have been performed and the indicated conditions have been met.

3.2 INSTALLATION

A. Installation shall be in accordance with the manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. After installation of tank and all fittings, the tank shall be water tested by filling the entire tank with water and monitoring the tank as well as all fitting connections for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field tank testing, the tank shall be completely emptied and dried.

END OF SECTION

SECTION 44 42 48

IN-LINE STATIC MIXERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials and installation of multi-element in-line static mixers used for dispersing chemical solutions in pipelines.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 00 – Piping and Fittings

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data and detail drawings showing all mixer parts and describing materials of construction by specification (such as ASTM) and grade or type. Show linings and coatings.

C. Submit head loss values over the specified flow range

D. Submit certification of NSF-61 compliance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mixers shall be manufactured by Komax, Kenics, Koflo, or equal.

2.2 DESIGN

A. Mixer shall provide uniform mixing of dilute aqueous solutions into the main water stream at the flow rates described under "Service Conditions".

B. Mixing shall be by rigid flow elements designed to produce turbulent mixing of the chemical solutions and process streams through the splitting and re-combining of the process flow.

C. Maximum pressure loss at the maximum process stream flow rate shall be as described under “Service Conditions”.

D. All wetted surfaces of the mixer shall be constructed of materials compatible with the chemical solution(s) being mixed or shall include a lining suitable to protect the base material from the chemical solution(s).

2.3 MIXER HOUSING

A. Mixer housing shall be fabricated of carbon steel, stainless steel, or PVC as described under “Service Conditions”.

B. Carbon steel housings shall conform to ASTM A283 or A53 Grade B. Thickness of steel shall be no less than Schedule 40.

C. PVC housings shall be Sch 80.

D. Stainless steel housings shall be Type 316 Schedule 40 or thicker.

2.4 END CONNECTIONS

A. End connections shall be as described under “Service Conditions” and shall conform to the requirements of Section 40 05 00.

B. Bolts, nuts, and gaskets for flanges shall conform to Section 40 05 00. Flanges shall be flat face.

2.5 INJECTION NOZZLES

A. Furnish injection nozzles near the upstream end of the mixer when called for under “Service Conditions”. Nozzle shall be 1” NPT minimum and aligned with the mixing elements to permit the installation of an injection quill.

2.6 COATING

A. Coat the exterior of the mixer the same as the adjacent piping (see Section 09 90 00). Apply prime coat to the exterior of carbon steel housings at the factory.

B. Coat the interior of the mixer as described under “service conditions”.

PART 3 EXECUTION

3.1 FABRICATION AND ASSEMBLY

A. All welds shall be full penetration.

B. Remove all slag by chipping or grinding. All surfaces receiving coatings or linings shall be free of sharp edges and burrs.

3.2 SERVICE CONDITIONS

A. Location: Upstream of filtration system

Equipment Tag Number:	
Housing Diameter:	16-Inch
Pressure Rating:	150 PSI
End Connections:	Flanged (Flat Face)
Maximum Length:	5 feet
Materials of Construction	As recommended by manufacturer
Maximum Pressure Loss	4 PSIG
Injection Port:	Yes
Process Fluid:	Potable Water
Chemical Solution(s):	93% Sulfuric Acid; 39% Ferric Chloride; and 12.5% Sodium Hypochlorite
Process Flow Range:	3,000 GPM

END SECTION

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SECTION 46 33 43

MOTOR OPERATED DIAPHRAGM CHEMICAL FEED PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes mechanically actuated diaphragm chemical metering pumps incorporating stepper motor drives.

1.2 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 40 05 75 – Piping and Equipment Identification

C. Section 46 33 85 – Chemical Metering Skids and Accessories

1.3 REFERENCES

A. ANSI / NSF - 61

B. National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.

B. Submit drawings showing general dimensions, installation requirements, materials of construction, connections, elevations, and operator interface.

C. Submit electrical schematics indicating power requirements, control inputs, and telemetry outputs

D. Submit operational narrative describing in detail the operation of the chemical feed pumps.

E. Submit documentation demonstrating certification to ANSI/NSF Standard 61.

F. Submit certification that materials of construction are compatible with the fluid being pumped.

G. Submit Operation and Maintenance Manuals in accordance with Section 01 33 00 prior to shipping pumps to the project site.

1.5 QUALITY ASSURANCE

A. All components of the metering pumps in contact with the chemical being pumped shall be certified to comply with NSF/ANSI Standard 61 (Drinking Water System Components – Health Effects).

B. The metering pump manufacturer shall be responsible for assuring that the materials in contact with the process chemical(s) are compatible with the process fluid. If the manufacturer believes that specific materials required by this specification are not appropriate for the process chemical(s), then the manufacturer shall request a substitution prior to bid.

1.6 WARRANTY

A. The metering pumps shall be warranted to be free of defects in material and workmanship for a period of 24 months from the date of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The chemical metering pump shall be Model DDA-FC, DDA-FCM or DME-FC manufactured by Grundfos, or equal pre-approved by the Engineer prior to bid.

2.2 GENERAL

A. Chemical metering pump shall be driven by a microprocessor controlled stepper motor providing a minimum of 1000:1 turndown ratio. The stepper motor is to be coupled to a flat, PTFE diaphragm via a gear assembly.

B. The pump shall operate at 100% stroke length throughout the pumps entire capacity range.

2.3 ENCLOSURE

A. Enclosure shall be rated to IP65 and NEMA 4X standards.

B. Drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure.

C. The pump design shall include provisions for optional positioning of the control interface/display, for right/left side and front mounting.

2.4 DRIVE

A. The motor shall be integral to the pump housing

B. An integral variable speed stepper motor shall be used to ensure the pump discharge phase extends throughout the full period between suction intervals.

C. Power supply shall be 120 volts, single phase, 60 hertz.

2.5 USER INTERFACE

A. User interface/display shall be backlit LCD. Display shall display the pump output in gallons per hour (gph). Backlight color (white, red, yellow, and green) shall indicate the pump status and alarm conditions.

B. Interface shall include a turn and push knob (click wheel) for easy menu navigation. The interface shall also include a priming button which initiates a time selectable prime cycle.

C. Interface shall include a lock function designed to protect against unauthorized settings changes.

D. A built in counter shall provide a running total of accumulated strokes, cumulative hours of operation, and dosing flow.

2.6 LIQUID END

A. Suction and discharge valve design shall incorporate a double ball arrangement. Spring loaded valves shall be available as an option.

B. Head shall incorporate an integral priming valve. The pump shall be able to automatically de-aerate the pump head without the need for external devices.

C. The suction and discharge connections shall accept polyethylene, PVDF, or PVC tubing via compression connections.

D. Pump diaphragm shall be completely constructed of PTFE.

E. Materials of construction shall be as follows for the chemical services indicated:

Service	Head	Gasket/ O-Ring	Valve Ball
Sodium Hypochlorite (0.8 – 13%)	PVC	FKM	Ceramic
Sodium Hydroxide (25 – 50%)	PP	EPDM	Ceramic
Sulfuric Acid (93 – 97%)	PVDF	PTFE	Ceramic
Ferric Chloride (39%)	PVC	FKM	Ceramic

F. Manufacturer shall certify that the materials listed above are appropriate for the services indicated and will not invalidate the pump warranty. Any change in materials required to satisfy the Manufacturer's warranty terms shall be at no additional cost to the Owner.

2.7 OPERATION

A. Repeatable metering accuracy shall be ±1% at constant hydraulic conditions throughout the entire output range. The pump shall be equipped with a calibration function which when initiated operates the pump for a set number of strokes and displays the anticipated pumped volume.

B. Pump shall include integral flow control system with selective fault diagnostic and pressure monitoring.

C. The pump shall be equipped with an operating mode that allows the suction stroke speed to be reduced to either 25% or 50% of maximum capacity.

D. The pump shall provide the following controls interfaces:

1. Analog re-scalable 4 – 20 mA signal input

2. External pump enable/disable interface

3. Discrete outputs for pump running and common alarm

4. Programmable proportional 4-20 mA output for pump flow

E. The pump shall be capable of operating in manual or automatic control modes.

1. In manual mode the pump shall be started and stopped at the operator interface and output adjustment shall be performed by adjustments to the turn and push knob.

2. In automatic control mode, the pump shall respond to a 4-20 mA analog input signal. The pump shall include an alarm for loss of input signal.

2.8 SERVICE CONDITIONS

A. Pumps satisfying the following service conditions shall be provided:

Tag No.	Pumped Liquid	Maximum Pumping Rate	Maximum Pressure	Model	Flow Measurement Required?
50-PMP-03	39% Ferric Chloride	4.3 GPH	100 PSI	DDA-FCM	Yes
50-PMP-02	12.5% Sodium Hypochlorite	3.6 GPH	100 PSI	DDA-FC	No
50-PMP-04	93% Sulfuric Acid	3.8 GPH	100 PSI	DDA-FC	No
50-PMP-01	25%-50% Sodium Hydroxide	9.6 GPH	100 PSI	DME-FC	No

2.9 ACCESSORIES

A. Pumps shall include all required electrical interface cables with pump-specific plug at one end and exposed wire at the other end for connection by the Contractor.

B. Refer to section 46 33 85 for additional accessories.

PART 3 EXECUTION

3.1 MANUFACTURER'S FIELD SERVICES

A. Provide Manufacturer's services at the jobsite for one day to advise during start-up, testing, and adjustment of the equipment; and to instruct the Owner in the proper operation of the equipment.

B. Provide Manufacturer's services at the jobsite for one day during startup after the treatment plant has been placed in operation. The purpose of this second visit will be to fine-tune the settings on the pumps and further instruct the Owner in the proper operation of the equipment.

3.2 FIELD OR SITE QUALITY CONTROL

A. Operate each pump for two hours over the full range of operating conditions using only water before supplying the pump with chemical.

B. Assure that pressure relief valves and backpressure valves have been set as specified prior to starting the pump.

END SECTION

SECTION 46 33 85

CHEMICAL METERING SKIDS AND ACCESSORIES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes complete factory pre-assembled chemical metering pump skids and accessories. Skids shall include metering pump(s), calibration column(s), back pressure valve(s), pressure relief valve(s), piping, fittings, isolation valves, and electrical panels required to provide a complete system.

1.2 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 40 05 75 – Piping and Equipment Identification

C. Section 46 33 43 – Motor Operated Diaphragm Chemical Feed Pumps

1.3 REFERENCES

A. ANSI / NSF – 61

B. National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 – Submittals.

B. Submit product datasheets for individual accessories.

C. Submit drawings showing general dimensions, installation requirements, materials of construction, connections, mounting interfaces, and elevations

D. Submit electrical schematics indicating power requirements, control inputs, and telemetry outputs

E. Submit documentation demonstrating certification of skid or all individual components in contact with the process chemicals to NSF/ANSI-61.

F. Submit certification that materials of construction are compatible with the fluid being pumped.

G. Submit procedure for factory pressure testing the skid. Submit factory test results before skids are shipped to the project site.

H. Submit Operation and Maintenance Manuals in accordance with Section 01 33 00 prior to shipping pumps to the project site.

1.5 QUALITY ASSURANCE

A. All components in contact with the chemical being pumped shall be certified to comply with NSF/ANSI Standard 61 (Drinking Water System Components – Health Effects).

B. Each chemical metering skid shall be subjected to a non-witnessed factory performance test using water as the test fluid. The factory performance test shall be designed to accomplish the following:

1. Pressurize the metering pump and skid piping to the design operating pressure for a minimum of two hours to ensure there are no leaks. Repair and replace any leaking joints and retest.

2. Confirm that the skid responds to all metering pump control signals and generates and transmits all specified alarm signals.

3. Pre-adjustment of skid accessories (e.g. pressure relief valves, backpressure valves)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The chemical metering skid shall be fabricated and assembled by the metering pump manufacturer or a company authorized to do so by the metering pump manufacturer.

B. The pumps for each chemical system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. The pump skid manufacturer shall be responsible for providing all equipment, valves, and piping within the skid boundary. The Contractor shall be required to mount the skid to the building and make connections only for inlet piping, outlet piping, and power and control cabling to the skid electrical junction box. Anchor bolts shall be furnished and installed by the Contractor based on the skid manufacturer's recommendations.

2.2 CHEMICAL COMPATIBILITY

A. All components of the skid in contact with the process chemical, designed to contain spillage of the process chemical, or likely to be splashed by the process chemical (including fasteners) shall be suitable for continuous exposure to the chemical being pumped.

2.3 CHEMICAL METERING PUMP

A. Refer to Specification 46 33 43 for chemical metering pump requirements.

2.4 SKID CONSTRUCTION

A. Pumps and appurtenances shall be positioned on the skid so that maintenance personnel will have convenient access to the pump. No accessories shall be located in such a way as to require their removal for removal of the pump.

B. Skids shall be constructed of high density polyethylene sheets, PVC sheets, polypropylene or fiberglass reinforced plastic (FRP) of minimum 1/2" thickness and gusseted to provide adequate stiffness and support to equipment.

C. The skid shall include two notched openings suitable for moving the skid with a forklift and shall include lifting lugs for overhead lifting.

D. The bottom of the skid shall include a drip-rim of at least 1-inch in height with a ½-inch minimum threaded hole with a plug in the bottom suitable for attachment of drain piping.

E. Piping and accessories shall be mounted to the skid using chemical resistant clips and fasteners. Attachment of clips or accessories using adhesive will not be accepted.

F. Provide means of mounting skid to support pad using chemical resistant clips and anchors.

2.5 CALIBRATION CYLINDER

A. Install a clear PVC calibration cylinder in the suction line. Calibration cylinder shall include easy to read graduations in mls and gph. Cylinder shall have a sealed top with an overflow connection allowing cylinder to be vented back to the chemical storage tank.

B. The calibration cylinder shall be piped so that all pumps on the skid. Duplex skids, when provided, can utilize a common column for calibration.

C. Calibration cylinders for 80 – 94% sulfuric acid shall be as above except with a glass tube instead of clear PVC.

D. Calibration cylinder capacity shall be appropriate to allow for 30-second draw-down at the maximum metering pump capacity.

2.6 PULSATION DAMPENERS

A. Each skid shall be equipped with a single-port pulsation dampener equipped with a pressure gauge.

B. Pulsation dampeners shall be chargeable using a Schrader valve.

C. Pulsation dampeners shall be designed to limit the pulsation amplitude to 2 psig or less.

D. The pulsation dampener body and bladder shall be constructed of CPVC and Viton respectively unless otherwise noted. Other materials may be substituted only if CPVC and/or Viton are incompatible with the liquid being pumped. PVC and Nordel (EPDM) shall be used for sodium hydroxide service.

2.7 PRESSURE RELIEF VALVE

A. Each pump shall be equipped with a pressure relief valve designed to protect the chemical feed system from over-pressure damage. The relief port shall be plumbed to the suction side of the metering pump.

B. The pressure relief valve shall be field adjustable between 10 – 150 psi via an adjustment screw.

C. The valve shall be installed as close to the pump as possible, upstream from the back-pressure valve, pressure gauge and pulsation dampener.

D. The valve body shall be constructed of CPVC. The diaphragm shall be constructed of Teflon.

2.8 BACKPRESSURE VALVE

A. Each pump shall be equipped with a back-pressure valve designed to provide a continuous back pressure to the pump and to prevent siphoning of chemical through the system.

B. The back-pressure valve shall be field adjustable between 0 – 150 psi via an adjustment screw.

C. The valve shall be installed as close to the pump skid discharge connection as possible, downstream from the pressure relief valve, pressure gauge and pulsation dampener.

D. The valve body shall be constructed of CPVC. The diaphragm shall be constructed of Viton or EPDM as appropriate for compatibility with the chemical being pumped. Diaphragms for sodium hydroxide service shall be EPDM.

2.9 MULTI-FUNCTION VALVE

A. Not used

2.10 PIPING, VALVES, AND OTHER APPURTENANCES

A. Piping shall be Schedule 80 PVC, CPVC, or PVDF as required for compatibility with the service chemicals and pressures. Piping size shall be appropriate for the maximum specified chemical dosage rate, but in no case shall be less than ½ inch.

B. Isolation ball valves shall be installed at the skid suction connection, skid discharge connection, calibration cylinder, discharge bleed connection, and as additionally shown on the drawings. Valves shall be of the true union type. Ball valves for sodium hypochlorite service shall be vented.

C. Install a pressure gauge on the discharge side of the pump. The gauge shall be 2-1/2 inch in diameter and have a scale high enough for the maximum pressure attainable by the pump. Gauges shall be liquid filled and include a chemically compatible seal isolating the gauge from the chemical.

D. Install a Y-type strainer on the suction line of the pump to prevent debris from entering the pump.

E. The metering pumps, valves, and appurtenances shall be installed using unions so that they can be removed without disturbing the remainder of the skid.

2.11 CONTROL PANEL / ELECTRICAL JUNCTION BOX

A. All skid power and control wiring shall terminate at an FRP NEMA 4X rated terminal box that will allow for selection of the duty metering pump.

2.12 SERVICE CONDITIONS

A. Service conditions shall be as described in Specification 46 33 43.

PART 3 EXECUTION

3.1 ASSEMBLY

A. Skids shall be fully assembled in the factory and shall only require mounting to the building or slab; inlet connection; outlet connection; and wiring to the skid junction box in the field.

3.2 CONNECTION LOCATIONS

A. Process connection locations shall be as shown on the plans.

B. Where specific connection locations are not shown on the plans, connection locations shall be defined by the Engineer during the submittal process.

3.3 TESTING

A. Assembled skids shall be pressure tested in the factory as described in Part 1.

B. Following installation operate each skid for two hours over the full range of operating conditions using water before supplying the pump with chemical.

C. Verify factory pressure relief valve and backpressure valves settings prior to supplying the pump with chemical.

3.4 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's field services shall be as specified in Section 46 33 43.

END SECTION

SECTION 46 61 21

PRESSURE FILTERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section describes materials, fabrication, installation, and testing of a complete pre-engineered pressure filtration system (PFS) for the removal of arsenic from groundwater.

B. The PFS manufacturer (Manufacturer) shall be responsible for the complete functional PFS and shall furnish the following components and services as part of the PFS:

1. Pressure vessels and internals.

2. Filtration media.

3. Face piping, fittings, flanges, and supports up to the limits shown on the drawings.

4. Process control valves and operators, flow control valves, and isolation valves as specified herein and as shown on the drawings.

5. Filter system control panel, PLC, HMI and associated electrical equipment.

6. Coordination with treatment plant controls integrator to mirror filter system control panel functions at the treatment plant SCADA workstation.

7. Factory finish coating of interior and exterior of equipment

8. Startup assistance.

9. Factory hydrostatic testing of vessels and appurtenances.

10. Supervision of media installation by the Contractor.

11. Seismic design of the vessel supports including definition of vessel anchorage requirements.

C. Responsibilities of the construction general contractor (Contractor) shall include the following:

1. Off-loading and installation of the PFS and appurtenances per the PFS manufacturer’s recommendations.

2. Disinfection of vessels, piping, and appurtenances.

3. Loading Manufacturer furnished filter media.

4. Construction of equipment pads and installation of anchor bolts.

5. Integration of the PFS PLC with the facility's SCADA system.

6. Field hydrostatic testing of assembled PFS.

7. Furnishing and constructing the following related project elements:

   a. Backwash equalization tank

   b. Chemical storage and feed systems.

   c. Backwash manifold, flow control valve, and backwash flow meter up to the point of PFS connection shown on the drawings.

   d. Bypass manifold, flow control valve and flow meter.

   e. Water quality instrumentation including chlorine residual, pH, and turbidity analyzers.

1.2 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 03 30 10 –Concrete Site Work

C. Section 09 90 00 – Painting and Coating

D. Section 40 05 00 – Piping and Fittings

E. Section 33 13 00 – Disinfection of Water System

F. Section 40 51 30 – HMI System Software

G. Section 40 91 25 – Magnetic Flow Meters

H. Section 40 96 31 – SCADA Control Loop Descriptions

1.3 REFERENCES

A. To the extent referenced herein, the following industry standards incorporated into this specification:

   1. American Society for Testing and Materials (ASTM)

   2. Americal Society of Mechanical Engineers (ASME)

3. ANSI/NSF Standard 61

4. American Water Works Association (AWWA)

5. California Building Code (Latest Edition)

6. National Electrical Code (NEC)

7. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.

B. Submit proof of Manufacturer's qualifications per Paragraph 1.5 within 2 weeks of the Contractor receiving notice to proceed with the project. Furnish reference project details, contact name, telephone number, and date of installation.

C. Submit the following information for review and approval prior to fabricating/procuring the PFS:

1. Submit shop drawings showing fabrication, assembly, installation, and wiring diagrams for the complete system, including ancillary systems being supplied by the Manufacturer. Shop drawings shall include, but not be limited to the following:

a. General arrangement drawings showing general dimensions, connections, elevations, and overall system configuration

b. Process and instrumentation diagrams showing the general process, valves, and instruments used to control and monitor the system.

c. Electrical one-line diagrams

d. Electrical control schematics and system wiring diagrams

e. Control panel drawings (including annotated panel front view and internal layout/wiring diagrams).

f. Catalog cuts for purchased components and details for manufactured components. Identify materials, surface preparation, and finishes. Include calculations of wall thickness for filter vessel.

2. Submit documents indicating the location of all external interfaces to the PFS (mechanical, plumbing, and electrical) to facilitate PFS installation.

3. Submit operational narrative describing in detail the operation of the PFS including normal operation, backwashing, flush-to-waste, and any other ancillary control loops and modes.

4. Submit offloading recommendations including shipping weight and dimensions, and any special offloading equipment that may be necessary to properly offload and position the filter vessels.

5. Submit anchor bolt design calculations signed and stamped by a Civil or Structural Engineer licensed in the State of California.

6. Exterior finish coating color charts.

D. Submit the following documents prior to shipping the PFS to the project site:

1. Submit Operation and Maintenance Manuals in accordance with Section 01 33 00.

2. Pressure test reports and certificates of inspection for each vessel in accordance with procedures for ASME pressure rating and ASME Boiler and Pressure Vessel Code. Reports shall be furnished not later than the time of delivery of the vessels.

3. Factory test and inspection reports regarding all factory-applied linings and coatings for vessels and piping. Reports shall indicate that the linings and coatings have been applied in accordance with these specifications on surfaces receiving the specified preparation. Records of film thickness and holiday testing shall be included. Reports shall be furnished not later than the time of delivery of the vessels.

E. Following loading of the filter media, submit certification that the Manufacturer, or Manufacturer's authorized representative witnessed loading and initial backwashing of the filter media and that the media was placed and conditioned in accordance with the Manufacturer's recommendations.

1.5 QUALITY ASSURANCE

A. The Manufacturer of the PFS shall have the following minimum qualifications:

1. Have previously furnished at least five (5) arsenic removal pressure filtration potable water treatment systems within the United States, designed for a minimum of 1,000 gpm. Manufacturer's services on these projects shall have included supply and integration of the vessels, media, valves, and PFS controls.

2. The manufacturer shall also have at least one PFS installation in the State of California within the last five years that required approval from the California State Water Resources Control Board Division of Drinking Water.

B. Welders shall be qualified for the welding processes and the procedures to be used under ASME Boiler and Pressure Vessel Code, Section IX.

C. All components of the PFS in contact with the process water shall be certified to comply with ANSI/NSF Standard 61 (Drinking Water System Components – Health Effects).

PART 2 PRODUCTS

2.1 MANUFACTURER'S

A. The manufacturer of the PFS shall be Pureflow, Robert's Filter, Tonka, Filtronics, or equal meeting the qualification requirements set forth above.

2.2 DESIGN CRITERIA

A. The system shall be designed based on the following operational criteria:

1. PFS flow rate: 3,000 gallons per minute
2. Number of independent filter vessels: 3 duty (no standby)
3. Maximum flow rate per filter: 1,000 gallons per minute
4. Filter orientation: Vertical side-shell
5. Filter size: twelve (12) foot diameter
6. Vessel pressure rating: 125 psig
7. Range of supply pressure: 40 – 60 psig
8. Backpressure at treated water discharge manifold (into water distribution system): 40 psig minimum.
9. Backwash water shall be supplied from the distribution system via an external, Contractor furnished, source with a maximum flow rate of 2,262 gallons per minute at 50 psig (upstream of Contractor furnished globe flow control valve)

B. The well is currently offline. Average Raw water quality from 2004 - 2019 is as follows:

Parameter	Value	Units
Alkalinity	111.5	mg/L as CaCO3
Arsenic	11.06	µg/L
Calcium	19.5	mg/L
Chloride	28.6	mg/L
Color	0	Units
E.C.	355.75	umho/cm
Fluoride	150	µg/L
Hardness	70.25	mg/L as CaCO3
Iron	8.32	µg/L
Magnesium	5.15	mg/L

Manganese	0.70	µg/L
pH	7.62	Units
Sodium	32.98	mg/L
Sulfate	6.45	mg/L
TDS	235	mg/L
Turbidity	0.15	NTU

C. California Building Code Seismic Design Parameters:

Parameter	Value
S_S	0.676g
S_1	0.267g
Site Class	D
Design Category	D
F_a	1.259
F_v	2.066
PGA	0.279g
S_{MS}	0.851g
S_{M1}	0.552g
S_{DS}	0.568g
S_{D1}	0.368g
F_{PGA}	1.321
PGA_M	0.371g
C_{RS}	0.952
C_{R1}	0.951

D. California Building Code Wind Design Parameters:

Parameter	Value
Wind Velocity	110 MPH
Risk Category	4
Exposure Category	B

E. Wind and Seismic Importance Factor: 1.5

F. Pressure vessels shall be designed and fabricated in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII and shall be so stamped.

G. The vessels, skid piping, and all other shop assembled appurtenances of the system shall be reinforced and supported with structural members as required such that the assembled components can be transported and off-loaded without distortion. The components shall be provided with lifting lugs to enable setting the equipment on a concrete foundation. The vessels shall be designed and drilled for installation and anchoring to a concrete slab.

H. The PFS will be subjected to the following environmental conditions:

1. The filter vessels, control panel cabinet and appurtenances will be located outdoors and uncovered.

2. Ambient temperature range: 15 ºF – 115 ºF

3. Water temperature range: 65 ºF – 80 ºF

I. The filtration system shall meet the following finished water performance requirements.

1. Arsenic: Less than 0.007 mg/L

2. Turbidity: Less than 0.2 NTU

3. Iron: Less than 0.05 mg/L

4. Manganese: Less than 0.01 mg/L

J. Pressure Drop – Total pressure drop across the system shall be limited to 20 psig (with dirty filter) at the design flow rate.

2.3 FILTER VESSELS

A. Filter vessels shall be single compartment, 12 feet in diameter with a minimum sidewall height as necessary for no less than 40% bed expansion during backwashing or 6 feet, whichever is greater.

B. Vessel shall be constructed in accordance with ASME Boiler and Pressure Vessel Code Section VIII, Division I requirements with ASME code stamp required.

C. A minimum of two accessways shall be provided on each vessel. One accessway on the top head shall be 12 inch by 16 inch minimum elliptical, equipped with a stainless-steel chain to prevent the cover from falling. The second manway shall be located on the side shell near the bottom but above the underdrain system. The manway shall be a minimum of 24 inches in diameter, circular. The manways shall be sized to accommodate the repair and/or removal of the largest single internal component. Removable davits or hinge system shall be provided to support the manway cover when opened or removed from the vessel.

D. Underdrain System:

1. Lower header manifold shall be Schedule 80 PVC or 316L stainless steel.

2. Lower laterals shall be 316L stainless steel pipe with wedgewire screens.

3. Design shall ensure uniform collection of the effluent water and uniform distribution of backwash water from the entire filter bed.

4. Underdrain system shall be rigidly supported inside the filter using stainless steel attachments.

E. Influent Distributor and Backwash Water Collection:

1. Upper manifold, distributor lateral, and fittings shall be Schedule 80 PVC or Schedule 40 stainless steel with stainless steel accessories.

2. Design shall ensure uniform distribution of the influent water and uniform collection of backwash water from the entire filter bed.

3. Design shall accommodate backwashing at a rate of 20 gpm/square foot of filter surface area without loss of filter media.

4. System shall be rigidly supported inside the filter.

F. Each filter vessel shall include a combination air valve and a separate manual air release valve at the high point of the vessel head. Combination air valves shall have an operating pressure of 200 psi, with 2-inch screwed or flanged fitting. Valves shall be APCO, Val-Matic, or equal. Plastic air valves will not be accepted. The combination valve vent and manual air release ball valve shall be plumbed down the side of the vessel to within 4' of the vessel slab. Each vessel shall also include a pressure relief valve sized to protect the vessel from over pressurization.

G. Provide ladder tie-off points near the air release valves and top accessway.

2.4 VESSEL SUPPORTS

A. Each of the contact tank and filter vessels shall be supported on four (4) legs welded to the side shell. The legs shall be coped to the vessel shell.

2.5 FILTER MEDIA

A. Furnish one complete media load for each vessel for installation by the Contractor.

B. The placement of media in the filter vessels and initial backwashing shall be in accordance with, and only under the supervision of the Manufacturer or authorized representative. The Manufacturer's representative shall witness installation of the filter media, and upon completion shall submit a letter stating that the installation was performed in accordance with the Manufacturer's recommendations.

C. The following filter media shall be furnished and installed in the filters:

1. ¾" x ½" gravel to top of laterals

2. Three (3) inches of ½" x ¼" gravel

3. Three (3) inches of ¼" x 1/8" gravel

4. Three (3) inches of 1/8" x 1/16" gravel

5. Three (3) inches of graded garnet

    a. Specific Gravity: Approximately 3.6

    b. Effective Size: #8 - #12 garnet

    c. Uniformity Coefficient not greater than 1.4

6. Three (3) inches of graded garnet

    a. Specific Gravity: Approximately 3.6

    b. Effective Size: #30 - #40 garnet

    c. Uniformity Coefficient not greater than 1.4

7. Thirty-four (34) inches of Manganese Dioxide

    a. Specific Gravity: Approximately 2.4

    b. Effective Size: 0.30 – 0.35 mm

    c. Uniformity Coefficient not greater than 1.60

8. Five (5) inch anthracite cap

    a. Granular, angular shape, crushed anthracite coal

    b. Specific Gravity: Approximately 1.6

    c. Effective Size: 0.85 – 0.95 mm

    d. Uniformity Coefficient not greater than 1.40

D. Alternate media profiles recommended by the PFS supplier will be considered, but must be submitted for approval prior to bid.

2.6 VALVES

A. General

1. The Supplier shall furnish all valves as called for in these specifications, or as required for proper operation of the equipment in general. Valves shall be manufactured by a Manufacturer whose valves have had successful operational experience in comparable service.

2. Wherever stainless steel is specified in this section, it shall be Type 316 or Type 304 unless otherwise specified. Where dissimilar metals are being bolted, stainless-steel bolts shall be used.

3. The Supplier shall furnish all incidental materials necessary for installation of the valves such as flange gaskets, flange bolts, nuts and washers, and all other materials required for the complete installation.

4. The centerline of manually operated valves shall be located not more than 5 feet above the foundation level and shall be provided with handwheels. Valves over 5 feet to centerline shall be rolled toward the operating side to make the handwheel more accessible to an operator of average height. Valves shall be installed in all cases so that handles clear all obstructions when moved from full-open to full-closed position. All aboveground valves shall have a valve position indicator arrow to determine if the valve is open or closed.

B. Butterfly Valves

1. Butterfly valves shall be one-piece wafer type or short body, flanged type, conforming to AWWA C504, Class 150B. Minimum working differential pressure across the valve disc shall be 150 psi. Flanged ends shall be Class 125, ANSI B16.1. Valve shafts shall be Type 304 or 316 stainless-steel journals and static seals. 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	Cast iron or ductile iron	ASTM A 48, Class 40, ASTM A 126, Class B; or ASTM A 536, Grade 65-45-12
Exposed body capscrews and bolts and nuts	Stainless steel	ASTM A 276, Type 304 or 316
Discs	Stainless steel	ASTM A 276, Type 304 or 316
Disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A 276, Type 304 or 316
Seat material	Buna-N	--

C. Manual actuators on valves 6 inches and larger shall be gear actuators with handwheels. Manual operators shall be designed in accordance with AWWA C504 and shall have a disk position indicator designating the opened and closed position of the valve.

D. All vessel nozzles shall be equipped with a valve capable of isolating the vessel from the common PFS manifolds.

E. Isolation butterfly valves:

1. Butterfly valves shall be one-piece cast iron or ductile iron lug body with lug drilled and tapped to mate to ANSI 125/150 flat faced flanges.

2. Valves shall have a service rating of not less than 200 psi.

3. Valves shall have EPDM seats and 316 stainless steel stem and disc.

F. Rate of flow control valves:

1. Provide butterfly rate of flow control valves.

2. Butterfly valves shall be a one-piece cast iron or ductile iron body, EPDM seat, and 304 stainless steel stem and disc.

3. Valves shall be flanged or lug style to mate with ANSI class 125/150 flat face flanges.

G. Valve Tags – All valves shall include a corrosion and UV resistant tag securely wired to the operating handle. The tag shall include a unique valve tag number corresponding to the Supplier's process flow diagram.

2.7 VALVE ELECTRIC MOTOR OPERATORS:

A. Valve electric motor operators shall be installed on all process valves as required for proper unattended system operation. Pneumatically operated valves will not be accepted.

B. Unless otherwise indicated, all operators shall be in accordance with ANSI/AWWA C540.

C. The motor operator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weatherproof NEMA 4 assembly. The operator shall be a single or double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel and the worm gear shall be bronze. Gearing shall be grease or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout.

D. A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum

torque required on the handwheel under the most adverse conditions shall not exceed 60 foot-pounds, and the maximum force required on the rim of the handwheel shall not exceed 60 pounds. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel.

E. The motor shall be of the totally enclosed, nonventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 120-V, single-phase, 60-Hz current, and have Class F insulation and a motor frame with all dimensions in accordance with the latest revised NEMA MG Standards. All bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require operator disassembly or gearing replacement. The motor shall be furnished with a space heater suitable for operation on 120-V, single-phase, 60-Hz circuit unless the entire operator is a hermetically sealed, nonbreathing design with a separately sealed terminal compartment which prevents moisture intrusion.

F. All automatically controlled electric open/close valves shall be equipped with open and closed position switches that are wired to the PFS control panel.

G. Operators shall be supplied by the valve manufacturer and shall be current models.

2.8 PIPING

A. The vessels shall be provided with the following manifold nozzles for connection of Contractor-furnished piping. Manifold sizes shall be as shown on the plans:

1. Raw water (influent)

2. Filtered water (effluent)

3. Backwash water supply

4. Backwash water / flush-to-waste effluent

B. Piping 4 Inches and Smaller

1. Unless otherwise specified, piping shall be Schedule 40 black carbon steel conforming to ASTM A 53, Grade B, Type E or S, or ASTM A 135.

2. Fittings shall be flanged, screwed, or grooved-end.

C. Piping Larger Than 4 Inches

1. Unless otherwise specified, piping shall be Schedule 40 black carbon steel conforming to ASTM A 53, Grade B, Type E or S.

2. Fittings shall be flanged or grooved-end.

D. All connections to the contractor-furnished manifold piping and vessels shall be ANSI 125/150 flat faced flanges.

E. All piping and butt welded fittings shall be Schedule 40 steel with 150 pound flanges and shall conform to ANSI 16.5. Cast iron fitting shall conform to ANSI 16.1. All process piping and fittings shall be fusion bonded epoxy coated inside.

F. All pipe which will operate under pressure shall be properly tied or blocked, restrained, and supported at all fittings where the pipe changes direction, changes size, or ends, using suitable anchors. Exposed pipe shall be installed in straight runs parallel to the axis of the structures or equipment. Pipe runs shall be horizontal and vertical except that gravity drain lines shall be pitched down in the direction of flow not less than 1/8 inch per foot.

G. Piping shall be made up with a sufficient number of unions, flanged joints, grooved end joints, or flexible couplings to permit ready breaking of lines as necessary for inspection and maintenance and to allow for expansion and contraction and general flexibility.

2.9 FITTINGS

A. Flanges and flanged fittings shall conform to ANSI B16.5.

1. All fasteners shall include washers under both bolt head and nut.

2. Bolts, nuts and washers for joining hardware and flanges constructed of materials other than stainless steel shall be carbon steel conforming to ASTM A307, Grade B with ASTM A563A nuts and ASTM F436 washers. Hardware shall be hot dip galvanized in accordance with ASTM F2329.

3. Fasteners for joining stainless steel hardware and flanges shall be Type 304 or 316 stainless steel per ASTM A320 or ASTM A193; nuts shall be 304 or 316 stainless steel per ASTM A194 and washers shall be ASTM F436 Type 3.

4. Gaskets shall be full face, 1/16- to 1/8-inch thick for piping shall be one of the following nonasbestos materials:

a. Cloth-inserted rubber. Products: Manville 109, John Crane Co. Style 777, or equal. Gaskets shall be suitable for a pressure of 350 psi at a temperature of 82°C (180°F).

b. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 204°C (400°F).

c. EPDM/EPT elastomer gasket material in accordance with ASTM D 2000, SAE J-200, BA-CA-DA. Gaskets shall be suitable for a pressure of 350 psi at a temperature of 82°C (180°F).

5. Flanges at site piping interface connection points shall be AWWA C207, Class D, flat face flanges.

B. Threaded fittings shall be Class 300, malleable iron conforming to ANSI B16.3 or forged steel fittings conforming to ANSI 16.11.

C. Flexible couplings (if used) shall be as follows:

1. Steel couplings, Dresser Style 38, Smith-Blair Type 411, Baker Series 200, or equal.

2. Bellows-type flexible expansion joints shall be Proco Style 240 with EPDM liner and cover or equal. Bellows-type joints shall incorporate stainless steel flanges to provide reliable sealing at the system design pressure.

D. Grooved-end couplings shall be flexible or rigid type (depending on location and application), square cut groove, per AWWA C606. Couplings shall be Victaulic Style 77 (7 for rigid), Gustin-Bacon Figure 100 or equal. Grooved-end coupling shall not be used within the adsorber vessels. Bolts and nuts shall be Type 316 stainless steel.

E. Butt-welded steel fittings shall be carbon steel pipe of the same wall thickness as adjoining pipes conforming to ASTM 234 WPB and ANSI B16.9. Welds shall be in conformance with AWWA C206.

2.10 INSTRUMENTATION

A. Flow Meters:

1. Each vessel shall be equipped with a flow meter capable of being read locally and at the Filter System Control Panel.

2. Flow meters shall measure both production flow and flush-to-waste flow.

3. Flow meters shall be flanged Siemens Sitrans FM electromagnetic flowmeter. Sensor shall be MAG 5100 W with MAG 5000 transmitter per Section 40 91 25.

4. Flow indicators shall be mounted in a location visible to operators and shall include a sun-cap or sun-shade designed for continuous exposure to direct sunlight, durable, and sufficient to protect the indicator screen from sunlight.

B. Pressure Transmitters:

1. Independent pressure transmitters shall be furnished for the common filter influent manifold and for the individual filter effluent pipes.

2. Transmitter shall read gage pressure with an operating range of 0 to 100 psi.

C. Pressure Gauges: The vessel piping shall be equipped with pressure gauges to indicate the pressure of water entering and exiting each vessel. Connection size

shall be ½ inch. Range shall be 0 - 100 psi with an accuracy of 1 percent of full range. Gauges shall not be less than 4 1/2 inches in diameter, liquid filled, and designed for outdoor, uncovered service. Pressure gauge assemblies shall be isolated from process piping with a 1/2 inch bronze ball valve. Gauges shall have stainless steel or bronze bourdon tube and be fitted with shatterproof glass. Gauges shall be manufactured by Ashcroft, Crosby, Marshalltown, Marsh, or equal.

D. Sample taps equipped with valves shall be provided at the following locations:

1. Influent manifold

2. Effluent manifold (after collecting water from all three filters)

3. Individual filter effluent

2.11 CONTROLS

A. Refer to Specification 40 51 30 – HMI System Software for treatment plant control approach and control loop descriptions 40 96 31.

B. The PFS shall include one local control panel that will be installed outdoors on a concrete slab at the filter vessels.

C. The PFS control panel shall be enclosed in a painted steel or stainless steel NEMA 4X enclosure, for automatic operation of the filter system, including all aspects of the backwash sequence. The panel shall include:

1. Programmable Logic Controller (PLC), including a Central Processing Unit (CPU), Input/output (racks with I/O cards), and auxiliary equipment (Allen Bradley CompactLogix PLC).

2. HMI touch screen (Allen Bradley PanelView Plus 6, 10”).

3. Power: 120V, single phase, 60 Hz

4. Other ancillary components required for proper operation of the PFS:

5. Power and control interface for the motor operated filtration system valves.

D. The PFS controller shall allow for manual, automatic, off, and remote control operation. Automatic control shall be for fully unattended operation including normal filtration, backwashing, and flush-to-waste cycles.

E. The PFS control system shall be capable of coordinating with the treatment plant SCADA system to control the following treatment plant functions:

1. Filter vessel operation

2. Enable chemical feed pumps

F. Control of filter backwashing shall be by timer, differential pressure, and/or high turbidity alarm.

G. The PLC shall be fully programmed, staged, and debugged at the manufacturer's facility.

H. The PFS control system HMI shall be fully mirrored at the treatment plant SCADA workstation with all control and telemetry functions available.

I. Software documentation shall be provided consisting of fully annotated Ladder Logic Listing with cross reference of internal could and contact usage and location.

J. All wiring to field devices shall be terminated at a numbered terminal strip mounted directly in the panel.

K. An uninterruptable power supply (UPS) shall be provided to keep the PLC operational for no less than 10 minutes upon a power failure.

2.12 FACTORY COATINGS

A. The interior and exterior surfaces of the vessels and process piping shall be finish coated in the factory.

B. Prior to coating, all weld splatter and other projecting irregularities shall be removed by chipping or grinding, resulting in a smooth continuous surface, free of pits or edges. Internal wetted surfaces of the vessels shall be blast cleaned to NACE SSPC-SP5 or better. All other surfaces of the vessels, including the vessel exterior shall be blast cleaned to SSPC-SP6 or better.

C. 14 – 16 mils (14 mils min) of 100% solids epoxy, DEVOE Devran 133 or equal. Vessel lining shall be ANSI/NSF-61 certified for contact with potable water and compatible with the media being installed in the filter.

D. The exterior of the vessels, piping, and appurtenances shall be coated in accordance with Specification 09 90 00, System 2. Color to be selected by the Owner.

E. All piping and fittings shall be fusion bonded epoxy lined.

PART 3 EXECUTION

3.1 SHIPPING

A. Manufacturer will coordinate with the Contractor to arrange for transportation and delivery of the PFS equipment and media. Costs for shipping the PFS to the job site shall be included by the Manufacturer in bid.

B. The Contractor shall offload and inspect all equipment and materials against approved Shop Drawings at time of delivery and before installation. Equipment and materials damaged or not conforming to the approved Shop Drawings shall be

noted. The Manufacturer shall be notified immediately and the necessary steps shall be taken to repair or replace damaged and non-conforming equipment.

C. Equipment and materials received by the Contractor are under the care and responsibility of the Contractor. These items shall be stored by the Contractor in a dry location and protected from the elements, and shall be handled in an approved manner in accordance with the Manufacturer's recommendations. Contractor shall make provisions to protect materials on-site from theft, damage, or vandalism.

3.2 INSTALLATION

A. Installation of the PFS and related appurtenances shall be performed by the Contractor, and shall be in accordance with the Contract Documents and with the Manufacturer's drawings, instructions, and recommendations. Conflicts of information shall be called to the attention of the Engineer.

B. Contractor shall support external piping connected to the PFS so as to minimize the transfer of loads and stresses to the PFS components as much as possible.

3.3 DISINFECTION

A. The interior of the vessels and manifold piping shall be free of debris when received at the job site. The equipment shall be in a condition to be immediately pressure tested and disinfected without cleaning or extensive flushing required.

B. Disinfection of the vessels and manifold piping shall be by the Contractor.

C. The filters and manifold piping will be disinfected per the requirements and procedures in AWWA C653.

D. Each filter shall be sampled and tested for coliform and HPC bacteria after disinfection.

3.4 START-UP SERVICES AND TESTING

A. The PFS Manufacturer or Manufacturer's authorized representative shall perform the following field services.

1. Witness media loading.

2. Provide observation of initial backwashing and media conditioning.

3. Inspect the completed installation and prepare an inspection report.

4. Instruct the Owner's personnel in the operation and maintenance of all components.

5. Assist with start-up of the PFS

B. The Manufacturer or Manufacturer's authorized representative shall be present during media loading into the filters.

C. Prior to system startup, the Manufacturer or Manufacturer's authorized representative shall inspect the installed PFS and bring any issues or deficiencies to the Contractor's attention. After all issues have been corrected, the Manufacturer shall submit an inspection report to the Engineer certifying that the PFS has been properly installed in accordance with the Manufacturer's recommendations.

D. The PFS Manufacturer or Manufacturer's authorized representative shall spend no less than five (5) 8-hour days on site for startup assistance while the system is being placed into service, not including travel time. Startup assistance services provided by the Manufacturer will include assisting the Owner with optimizing chemical dosages, filter run times, and backwash procedures. The Manufacturer will also provide training to the Owner's personnel during this time period.

E. The PFS Manufacturer or Manufacturer's authorized representative shall return to the project site for two (2) days at a date within two months of startup selected by the Owner to address any Owner questions or operational issues.

F. If the PFS fails to meet any of the specified performance requirements or fails to operate automatically in a fully-unattended mode, the PFS Manufacturer shall be responsible for modifying and/or replacing the necessary equipment to bring the system into compliance and shall provide as many field support trips and hours as is necessary to correct the deficiencies.

END SECTION