CAMROSA WATER DISTRICT

NOTICE TO BIDDERS, CONTRACT PROPOSAL, AND SPECIFICATIONS FOR THE

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

Specification No. PW 21-04

EUGENE F. WEST, PRESIDENT
AL E. FOX
JEFFREY C. BROWN
TIMOTHY H. HOAG
TERRY L. FOREMAN

IAN PRICHARD
-ASSISTANT GENERAL MANAGER-

BIDS TO BE OPENED NOVEMBER 9, 2021
by 2:00 P.M.

CAMROSA WATER DISTRICT
7385 SANTA ROSA ROAD
CAMARILLO, CA 93012
STAFF CONTACT: (805) 482-8063

ENGINEERING DEPARTMENT

CAMROSA WATER DISTRICT

CONSTRUCTION DOCUMENTS

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

LOCATION: 6245 E. Camarillo Springs Rd,
Camarillo, CA 93012

SPECIFICATION NO.: PW 21-04

DATE: October 12, 2021

PREPARED BY:

Kevin Berryhill
Project Engineer
Provost & Pritchard

RECOMMENDED BY:

Ian Prichard
Assistant General Manager
Camrosa Water District

ENGINEERING DEPARTMENT

CAMROSA WATER DISTRICT

NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIERS

Complete digital bidding documents are available at Camrosa.com. You may download the digital documents from the District website.

If you discover any error or omission in the plans, specifications, or proposal, or have any question concerning the bidding documents, please contact:

Becca Bugielski, Project Manager
MKN and Associates
bbugielski@mknassociates.us
Telephone (805) 947-4971

Advise the person answering the phone that you have a "Bidding Question." Please do not call other staff members or consultants.

All bids must be sealed and submitted at or before 2:00 p.m., November 9, 2021, to the following:

Ian Prichard, Assistant General Manager
Camrosa Water District
7385 Santa Rosa Road
Camarillo, CA 93012

There will be a mandatory pre-bid meeting on October 28, 2021, at 9:00 AM. Contractors shall meet at the site.

After the bid opening, bid results may be posted online.

After a Notice to Proceed is issued to the successful bidder, all contacts should be through Becca Bugielski at (805) 947-4971.

NOTE: Please mark the outside of the envelope (and express shipment envelope, if applicable):

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS
SPECIFICATION NO. PW 21-04

Bids to be opened November 9, 2021, 2:00 p.m.

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CAMROSA WATER DISTRICT

ENGINEERING DEPARTMENT

NOTICE INVITING BIDS

FOR
1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

SPECIFICATION NO. PW 21-04

NOTICE INVITING BIDS

Pursuant to statute and to the authorization approved by the Board of Directors of the Camrosa Water District, NOTICE IS HEREBY GIVEN that sealed bids for the 1,2,3- TCP Removal Project for Conejo Wells, Specification No. PW 21-04, will be received by the Assistant General Manager at Camrosa's Headquarters, 7385 Santa Rosa Road, Camarillo, California, 93012, at or before 2:00 p.m. on November 9, 2021, at which time they will be publicly opened and read at or about said hour and date by the Assistant General Manager (or designated representative) at the above address.

The following contractors submitted their qualifications and were determined by the Board of Directors of the District as qualified to submit bids. Bids will not be accepted from any other contractors.

1. James C. Cushman, Inc.
2. Pacific Hydrotech Corporation
3. W.M. Lyles Co.

SCOPE OF WORK:

The proposed work consists of construction of a granular activated carbon (GAC) treatment plant and associated chemical feed systems, backwash management system, related equipment upgrades, and appurtenances. Specific improvements include installation of three pairs of owner-furnished GAC treatment systems; one owner-furnished carbon dioxide storage and dissolution system; two 100-HP vertical turbine booster pumps; 125,000 gallon bolted steel backwash tank; 85,000 gallon bolted steel treated water storage tank; sodium hydroxide storage and feed system; miscellaneous instrumentation; 1 MW standby engine generator with 12,000 gallon fuel tank; owner-furnished motor control centers; electrical service upgrade; motor and drive upgrades for four existing well pumps; yard piping; AC paved access road; storm water pond; perimeter chain link fence; and integration of controls and telemetry.

The proposal shall be submitted, and the work shall be performed by a Class A State of California licensed contractor in strict conformance with Specification No. PW 21-04, on file in the District's Engineering Department.

Copies of plans and specifications may be obtained through the District’s website. All questions concerning the bid document should be directed to Becca Bugielski, MKN, at (805) 947-4971 by October 29, 2021 at 5PM.

All prospective bidders shall abide by the provisions of the Bid Terms and Conditions listed in the project's specifications.

The District reserves the right to retain all proposals for a period of sixty (60) days after the bid opening date for examination and comparison and to delete any portion of the work from the Contract.

The District reserves the right to determine and waive non-substantial irregularities in any proposal, to reject any or all proposals, to reject one part of a proposal and accept the other. The bid shall be balanced so that each bid item is priced to carry its share of the cost of the work and also its share of the contractor's overhead and profit. The District reserves the right to delete any bid item to the extent that the bid is qualified by specific limitation. An unbalanced bid shall be considered as grounds for rejecting the entire bid. The District further reserves the right to make award to the lowest responsible bidder as the interest of the District may require.

The District will not consider awarding any contract based upon any proposal submitted by any contractor and will not consent to subletting any portions of the Contract to any subcontractor located in a foreign country during any period in which such foreign country is listed by the United States Trade Representative as discriminating against U.S. firms in conducting procurements for public works projects.

In accordance with the provisions of Division 2, Part 7, Chapter 1 of the California Labor Code, the California Department of Industrial Relations has established the general prevailing rates of per diem wages for each craft, classification, and type of work needed to execute contracts for public works and improvements. The per diem wages published at the date the Contract is advertised for bids shall be applicable. Copies of the prevailing rate of per diem wages are on file at the California Department of Industrial Relations and are available to any interested party at www.dir.ca.gov/DLSR/PWD/index.htm. Future effective wage rates, which have been predetermined, are on file with the Department of Industrial Relations, are referenced but not printed in said publication. The new wage rates shall become effective on the day following the expiration date and apply to this Contract in the same manner as if they had been included or referenced in this Contract.

No contractor or subcontractor may be listed on a bid proposal for a public works project submitted unless registered with the Department of Industrial Relations (DIR) pursuant to Labor Code section 1725.5 or unless the contractor or subcontractor qualifies for an exception from this requirement, for bid purposes only, as set forth in the Labor Code section 1771.1(a). If contractor or subcontractor believes that such an exception in 1771.1(a) applies, it must provide the applicable exception(s) in its bid proposal. Even those contractors or subcontractors who qualify for an exception under 1771.1(a) must be registered with DIR at the time of award, if such award is made on or after April 1, 2015.

No contractor or subcontractor may be awarded a contract for public work on a public works projected awarded on or after April 1, 2015 unless registered with DIR pursuant to Labor Code section 1725.5.

Furthermore, the current Federal General Wage Determinations apply for this project as predetermined by the Secretary of Labor. If there is a difference in the Federal minimum wage rates and the California Department of Industrial Relations for similar classifications of labor, the Contractor and its subcontractors shall pay not less than the higher wage rate.

The wage rate for any classification not listed by the Federal Department of Labor or the California Department of Industrial Relations, but which may be required to execute the Contract, shall be in accord with specified rates for similar or comparable classifications or for those performing similar or comparable duties, within the agencies determinations.

The Contractor may substitute securities for retention monies pursuant to Public Contract Code, Section 22300.

Dated this 12th day of October, 2021

CAMROSA WATER DISTRICT

CAMROSA WATER DISTRICT

ENGINEERING DEPARTMENT

BID TERMS AND CONDITIONS

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

SPECIFICATION NO. PW 21-04

BID TERMS AND CONDITIONS

Requirement to Meet All Bid Provisions - Each bidder shall meet all of the specifications and bid terms and conditions. By virtue of the bid submission, the bidder acknowledges agreement with and acceptance of all provisions of the specifications except as expressly qualified in the proposal. Non-substantial deviations may be considered provided that the bidder submits a full description, explanation of, and justification for the proposed deviations. Whether any proposed deviation is non-substantial will be determined by the District in its sole discretion.

License - In accordance with the provisions of California Public Contract Code Section 3300, the District has determined that the bidder shall possess a valid applicable class Contractor's License as specified in the Contract documents. Failure to possess the specified license at the time of bid submittal shall render the bid as non-responsive and shall act as a bar to award the Contract to any bidder not possessing said license.

Communications Regarding Bid - If a prospective bidder is in doubt as to the true meaning or intent of any part of the Contract documents, or discovers discrepancies or omissions, the bidder may submit questions to Becca Bugielski, MKN, at (805) 947-4971 or bbugielski@mknassociates.us. . Interpretations or corrections of the Contract documents shall be made by addendum duly issued by Becca Bugielski. A copy of such addendum shall be posted online through the District website. Such addendum shall be considered a part of and incorporated in the Contract documents.

All timely requests for information submitted in writing will receive a written response from the District. Telephone communications with District staff are not encouraged but will be permitted. However, any such verbal communication shall not be binding on the District.

Bidder's Bond Requirement - Bidders shall provide a properly executed bidder's bond (contained herein), cashier's check, or other bidder's security payable to the Camrosa Water District to accompany the proposal in the amount of ten percent (10%) of the total bid. The proceeds thereof will become the property of the District if the bidder fails to or refuses to execute the contract within ten (10) calendar days after the District has notified the bidder of intent to award the bid or within ten (10) calendar days after notice of the award has been sent by mail to the bidder, whichever occurs first. It is the Camrosa Water District Board of Directors' policy that the bid bond or other bidder's security will not be waived due to calculation errors made by the bidder. Additionally, the proceeds of the bidder's bond will become the property of the District if the bidder fails to or refuses to furnish satisfactory bonds or evidence of insurance required in the contract construction documents within ten (10) days after the bid has been awarded. The bond shall be sufficient and duly executed by a surety admitted to do business in the State of California. All bid bonds or substitutes therefore will be returned upon timely execution of the Contract and the filing of satisfactory insurance certifications and bonds by successful bidder.

Bid Submission - Each bid must be submitted on the form(s) provided in the proposal. The proposal shall be enclosed in an envelope, which shall be sealed and addressed to the Assistant General Manager, Camrosa Water District, 7385 Santa Rosa Road, Camarillo, California 93012. In order to guard against premature opening, the proposal shall be clearly labeled with the bid title, name of bidder, and date and time of bid opening. If the proposal is delivered to the District via

express delivery, or other priority mail service, the above information must also be included on the outside shipment envelope.

Competency of Bidders - In selecting the bidder for award of the contract, consideration will be given not only to the total amount of the bid, but also to the general competency of the bidder for the performance of the work covered by the proposal. To this end, the District has selected qualified contractors through a prequalification process. The names of the pre-qualified contractors are located on page 5 of these specifications.

Submission of One Bid Only - No individual, or business entity of any kind, shall be allowed to make or file or to be interested in more than one bid, except an alternative bid when specifically requested. However, an individual who has quoted prices on materials to a bidder submitting a proposal is not thereby disqualified from quoting prices to other bidders submitting proposals.

Bid Withdrawal - A bidder may withdraw its proposal without prejudice prior to the time specified for the bid opening by submitting a written request to the Business Manager for its withdrawal. If this occurs, the proposal will be returned to the bidder unopened. No proposal received after the time specified or at any place other than the place stated in the Notice Inviting Bids will be considered. All bids will be opened and declared publicly. Bidders or their representatives are invited to be present at the opening of the bids.

Bid Quotes and Unit Price Extensions - The extensions of unit prices for the quantities indicated and the lump sum prices quoted by the bidder must be entered in figures in the spaces provided on the Bid Submission Form(s). The Bid Submission Form(s) must be totally completed. If the unit price and the total amount stated by any bidder for any item are not in agreement, the unit price alone will be considered as representing the bidder's intention and the total will be corrected to conform to the specified unit price.

Bid Retention and Award - The District reserves the right to retain all proposals for a period of sixty (60) days after the bid opening date for examination and comparison. The District also reserves the right to determine and waive nonsubstantial irregularities in any proposal, to reject any or all proposals, to reject one part of a proposal and accept the other, except to the extent that the proposals are qualified by specific limitations, and to make award to the lowest responsive and responsible bidder as the interest of the District may require.

Labor Actions - In the event that the successful bidder is experiencing a labor action at the time of the award of the bid (or if its suppliers or subcontractors are experiencing such a labor action), the District reserves the right to declare said bidder is no longer the lowest responsible bidder and may accept the next acceptable low bid from a bidder that is not experiencing a labor action and declare it to be the lowest responsible bidder.

Contract Requirement - The bidder to whom award is made, shall execute a written contract with the District within ten (10) calendar days after notice of the award has been sent by mail to the address given in the proposal or within ten (10) calendar days after receipt by bidder of oral communication of the intent to award, whichever occurs first. The Contract shall be made in the form adopted by the District and incorporated in these specifications. The bidder warrants that bidder possesses, or has arranged through subcontracts, all capital and other equipment, labor and materials to carry out and complete the work hereunder in compliance with all Federal, State,

County, City and Special District Laws, Ordinances, and Regulations which are applicable; and further, bidder shall comply with all Federal, State, County, City and Special District Laws, Ordinances, and Regulations which are applicable.

Failure to Accept Contract – If, upon notification of intent to award the bid by the District, the bidder fails to enter into the Contract within the specified time period, the pending award will be annulled. Any bid security will be forfeited in accordance with these Bid Terms and Conditions if a bidder's bond or security is required. An award may be made to the next lowest responsive and responsible bidder who shall fulfill every term and condition of the bid.

Business Tax - The City of Camarillo and Ventura County Business Tax Ordinance requires that a Business Tax Receipt be obtained before any business, trade, profession, enterprise, establishment, occupation, or calling is conducted within the City or County. The amount of the tax is based on gross receipts resulting from business conducted in the City of Camarillo or unincorporated areas of the County and is required to be paid when business is conducted even though the principal location of the business may be outside of the City or County or a Business Tax Receipt has been issued to them by another agency. Issuance of a Business Tax Receipt is only evidence of the fact that the tax has been paid. It does not sanction or approve any activity not otherwise permitted. Verification that the bidder has a valid Business Tax Receipt will be obtained by the District prior to the execution of the Contract.

Faithful Performance Bond Requirement - The bidder to whom the Contract is awarded (Contractor) shall execute the Contract and furnish a surety bond in the amount of one hundred percent (100%) of the Contract bid price guaranteeing the faithful performance of the Contract. The bond shall remain in force for a period of one year after the date of recordation of Notice of Completion by District. The bond shall be sufficient and duly executed by a surety admitted to do business in the State of California.

Material Suppliers and Laborer Bond Requirement - The Contractor shall furnish a surety bond by an admitted surety in the amount of one hundred percent (100%) of the Contract bid price to secure the payment of claims for materials and labor provided by others in performing the work. The bond shall be sufficient and duly executed by a surety admitted to do business in the State of California.

Antitrust Claims - In accordance with Section 4552 of the Government Code, in submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act [Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code], arising from purchases of goods, materials or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the bidder.

Prevailing Wages and Minority Group Skill Upgrade and Employment - Bidders are hereby notified that pursuant to the provisions of the California Labor Code the California Department of Industrial Relations has ascertained the general prevailing rate of per diem wages and the general prevailing rate for legal holiday and overtime work in the locality in which this work is to be performed for each craft, classification or type of worker needed to execute the contract. Such

wage scale is set forth at length in a Schedule of Prevailing Rates of Wages that is on file at the California Department of Industrial Relations and is available at www.dir.ca.gov/DLSR/PWD/index.htm. The published prevailing wage rates that the Contractor shall pay are hereby incorporated in and made a part of these Bid Terms and Conditions.

The bidder to whom the Contract is awarded shall assist in locating, qualifying, hiring, and increasing the skills of minority group employees and applicants for employment, as set forth in Executive Orders 11246 and 11375.

Public Records Act - All information contained in the proposal is public information once opened unless it is bona fide trade secret information and is labeled as such. Any California Public Records Act request for information labeled as a trade secret shall be forwarded to the bidder for legal defense. Failure on the part of the bidder to promptly defend against any such request or action shall be deemed an unqualified waiver of the confidentiality of all trade secret information in the proposal.

Recycled Purchase Requirement - Bidders are hereby notified that pursuant to the provisions of Sections 22150–22154 of the California Public Contract Code the District is required to purchase recycled products as defined in Section 12200 of the same Code if the product fitness and quality are equal to the nonrecycled product and available at the same or a lesser total cost than nonrecycled items. Bidders shall offer products and prices to the District that meets these requirements.

CAMROSA WATER DISTRICT

ENGINEERING DEPARTMENT

PROPOSAL

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS
SPECIFICATION NO. PW 21-04

ENGINEERING DEPARTMENT

PROPOSAL

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS
SPECIFICATION NO. PW 21-04

Specification No.:	PW 21-04
Bids to be Received on:	November 9, 2021, at or before 2:00 p.m.
Completion Time:	330 Calendar Days
Liquidated Damages:	$1000 Per Calendar Day
Number of Pages in Proposal:	19

CONTRACTOR

Name _____

Street Address _____

City _____ State _____ Zip Code _____

Telephone Number _____

Fax Number _____ (Optional)

The bid shall be balanced so that each bid item is priced to carry its share of the cost of the work and also its share of the contractor's overhead and profit. Work not specifically listed in the bid schedule as a line item will be distributed by the contractor in the line items as they seem fit. The District reserves the right to delete any bid item to the extent that the bid is qualified by specific limitation. An unbalanced bid shall be considered as grounds for rejecting the entire bid.

SUBMIT PAGES 13 THROUGH 29 FULLY EXECUTED WITH THIS PROPOSAL

LIST OF DOCUMENTS

TO BE SUBMITTED WITH PROPOSAL

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

SPECIFICATION NO. PW 21-04

INSTRUCTIONS FOR SIGNING PROPOSAL, BONDS AND CONTRACT

Corporations

a) Give name of Corporation.
b) Signatures: President or Vice President and Secretary or Assistant Secretary.
c) Affix corporate seal and notary's acknowledgment.
d) Others may sign for the corporation if the District has been furnished a certified copy of a resolution of the corporate board of directors authorizing them to do so.

Partnerships

a) Signatures: All members of partnership. One may sign if District has a copy of authorization.
b) Affix notary's acknowledgment.

Joint Ventures

a) Give the names of the joint venturers.
b) Signatures: All joint venturers. One may sign if District has a copy of authorization.
c) Affix notary's acknowledgment.

Individuals

a) Signature: The individual.
b) Affix notary's acknowledgment.
c) Another may sign for the individual if the District has been furnished a notarized power-of-attorney authorizing the other person to sign.

Fictitious Names

a) Show fictitious names.
b) Satisfy all pertinent requirements shown above.

Bonds

a) In addition to all pertinent requirements above, give signature of Attorney-in-fact and apply surety's seal and provide address and telephone number of said surety.

PLEASE ADHERE TO THE APPLICABLE SIGNING INSTRUCTIONS

CONTRACTOR'S PROPOSAL STATEMENT

Camrosa Water District
Camarillo, California 93012

Pursuant to the foregoing Notice Inviting Bids, the undersigned declares that he/she has carefully examined the location of the proposed work, that he/she has examined the Plans and Specifications and read the accompanying instructions to bidders, and hereby proposes to furnish all materials and to do all the work required to complete such work in accordance with such Plans and Specifications for the prices set forth in this Proposal.

The undersigned has carefully checked all the figures in this Proposal and understands that District will not be responsible for any error or omission on the part of the undersigned in preparing this bid nor will District release the undersigned on account of such error or omission.

The undersigned swears or affirms under penalty of perjury that the information regarding the Contractor's License is true and correct.

The undersigned further agrees that in case of default in executing the required Contract within the applicable ten (10) calendar days or thereafter failing to provide the necessary bonds within ten (10) calendar days after the Contract has been fully executed, the proceeds of check or bond accompanying the bid shall become the property of the Camrosa Water District. Furthermore, the undersigned is advised and understands that it is a District policy that bids/bonds will not be waived due to calculation errors made by the bidder.

Licensed in accordance with an act providing for the registration of Contractor's License:

No.	Class	Expiration Date
_____	_____	_____
No.	Class	Expiration Date
_____	_____	_____

Names of Co-Partners or Corporate Officers and Titles: _____

_____

_____ _____
Signature of Bidder Title

_____ _____
Signature of Bidder Title

_____ _____
Name of Contractor or Firm Date of Submittal

Telephone: (___) _____

Address _____

_____ _____
Doing Business as: Individual / Partnership / Corporation State of Incorporation

Federal Tax Identification Number: _____

ALL SIGNATURES MUST BE NOTARIZED
(Attach or Affix Executed Acknowledgment Form and Corporate Seal if Applicable)

PROPOSED SCHEDULE OF WORK AND PRICES

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

***Notice to Bidders**:*

Schedule "A" is for the complete construction of the 1,2,3- TCP Removal Project for Conejo Wells

1. complete and in place in accordance with the Contract Documents.

Bidders are required to bid on all Schedules.

SCHEDULE "A"
1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

Item No.	Payment Reference	Description	Quantity	Unit	Unit Price	Total
1		Mobilization, Bonds and Insurance	1	LS		
2		Demolition and Clearing	1	LS		
3		Worker Protection	1	LS		
4		Traffic Control	1	LS		
5		Dust Control	1	LS		
6		Prepare and Implement SWPPP	1	LS		
7		Implement Environmental Mitigation Measures	1	LS		
8		Installation and Testing of Owner-Furnished GAC Systems	1	LS		
9		Installation and Testing of Owner-Furnished Carbon Dioxide System	1	LS		
10		Installation and Testing of Owner-Furnished Electrical Panels	1	LS		
11		Furnish, Installion and Testing of Generator and Fuel Tank	1	LS		
12		Asphalt Driveway	1	LS		
13		Crushed Rock Surfacing	1	LS		
14		Grading/Earthwork	1	LS		
15		Furnish and Install 126,000-Gallon Bolted Backwash Tank	1	LS		

SCHEDULE "A" 1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS						
Item No.	**Payment Reference**	**Description**	**Quantity**	**Unit**	**Unit Price**	**Total**
16		Furnish and Install 85,000-Gallon Bolted Treated Water Tank	1	LS		
17		Furnish and Install Vertical Turbine Booster Pump Station	1	LS		
18		Furnish and Install Sodium Hydroxide Storage Tank and Enclosure	1	LS		
19		Furnish and Install Analyzer Enclosure	1	LS		
20		Furnish and Install Yard Piping	1	LS		
21		Furnish and Install Santa Rosa 8 Pre-lubrication and Chlorination	1	LS		
22		Furnish and Install Chain Link Fence and Gates	1	LS		
23		Painting and Coating	1	LS		
24		Electrical	1	LS		
25		Instrumentation & Controls Integration	1	LS		
26		Startup & Testing	1	LS		
27		Operation & Maintenance Manuals and Record drawings	1	LS		

Total Schedule "A" $_____

Total Schedule "A": _____

(Amount Written in Words)

PROPOSED SCHEDULE OF WORK AND PRICES - Continued

SCHEDULE "B" TERMINATION OF LIABILITY						
Item No.	**Payment Reference**	**Description**	**Quantity**	**Unit**	**Unit Price**	**Total**
1.	709	Termination of Liability	1	LS	$1.00	$1.00

Total Schedule "B" $1.00

BID SUMMARY	
Schedule "A" + Schedule "B"	$

Total Bid Price: _____

(Amount Written in Words)

Contractor's Name: _____

Contractor's Signature: _____

PROPOSED SCHEDULE OF WORK AND PRICES

*ADDITIONS/DEDUCTIONS

TOTAL AMOUNT BID $_____

	Schedule/Bid Item No.	New Total	
Addition for:		$_____	+$_____
Addition for:	_____	_____	+_____
Addition for:	_____	_____	+_____
Deduction for:	_____	_____	– _____
Deduction for:	_____	_____	– _____
Deduction for:	_____	_____	– _____

Adjusted Total Bid Amount: $_____

Adjusted Total Bid Amount in Words: _____

**Sales Tax Adjustment (If Applicable): _____

* Provisions are made for the bidder to include additions or deductions in price for bid item(s) to reflect last-minute adjustments in bidder's total bid amount. The bid item for which the addition or deduction in price is made shall be listed by the bidder as indicated above. The unit price for that item (if applicable) shall be adjusted by dividing the bid quantity into the new total amount as determined after adding or subtracting the amount listed by the Contractor for such item.

** Sales tax deduction entered on this line is the amount the bid is to be reduced in order to receive credit for purchases made in the City or County pursuant to Bid Terms and Conditions, Sales Tax Reimbursements.

The following addenda are acknowledged:	Number	Date
(Bidder must fill in number and date of each addendum or may enter the word "None" if appropriate.)	_____	_____
	_____	_____
	_____	_____

I make this Proposal and certify under penalty of perjury that all the statements in this Proposal that I have signed are true and correct.

_____ _____

Contractor's Name Date Contractor's Name Date

_____ _____

Signature and Title Signature and Title

BIDDER'S BOND TO ACCOMPANY PROPOSAL
(in lieu of cash or cashier's check)

KNOW ALL PERSONS BY THESE PRESENTS:

That we, _____, as Principal, and _____

_____, as Surety, acknowledge ourselves jointly and severally bound to the Camrosa Water District (District), the obligee, for ten percent (10%) of the total bid, to be paid to said District if the Proposal shall be accepted and the Principal shall fail to execute the Contract tendered by the District within the applicable time specified in the Bid Terms and Conditions, or fails to furnish either the required Faithful Performance or Labor and Material Bonds, or fails to furnish evidence of insurance as required in the Standard Specifications, then this obligation shall become due and payable, and Surety shall pay to obligee, in case suit is brought upon this bond in addition to the bond amount hereof, court costs and a reasonable attorney's fee to be fixed by the court. If the Principal executes the Contract and furnishes the required bonds and evidence of insurance as provided in the bid documents, this bond shall be extinguished and released. It is hereby agreed that bid errors shall not constitute a defense to forfeiture.

WITNESS our hands this _____ day of _____, 20__.

_____
Contractor

By _____

Title _____

By _____

Title _____

_____
Surety

By _____

Title _____

FORM TO ACCOMPANY BID BOND

STATE OF CALIFORNIA)
COUNTY OF) SS.
CITY OF)

On this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for said County and State, residing therein, duly commissioned and sworn, personally appeared _____, known to be the _____ of _____ and the same person whose name is subscribed to the within instrument as the _____ of said _____ _____, and the said _____ duly acknowledged to me that he/she subscribed the name of _____ thereto as Surety and his/her own name as _____.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year first above written.

_____
Notary Public in and for said
County and State aforesaid

If cashier's check is submitted herewith, state check number _____ and amount $_____.

STATEMENT OF BIDDER'S QUALIFICATIONS

The bidder is required to state the bidder's financial ability and a general description of similar work performed.

Required qualifications: Bidders must hold a valid State of California Class A Contractor's License at the time the bid is submitted to the District, and must have satisfactorily completed at least three (3) Southern California municipal projects in the last three (3) years of comparable size to the scope of this project.

Number of years engaged in providing the work included within the scope of the specifications under the present business name: _____.

Continued

STATEMENT OF BIDDER'S QUALIFICATIONS– Continued

STATE OF CALIFORNIA, COUNTY OF _____

I am the _____ of _____, the bidder herein. I have read the foregoing statement and know the contents thereof, and I certify that the same is true to my knowledge, except as to those matters which are therein stated upon my information or belief, and as to those matters, I believe it to be true.

_____

_____

Executed on _____, 20___, at _____, California.

I declare, under penalty of perjury, that the foregoing is true and correct.

_____
Signature of Bidder

_____
Title

_____
Signature of Bidder

_____
Title

STATEMENT OF BIDDER'S PAST CONTRACT DISQUALIFICATIONS

Pursuant to Section 10162 of the Public Contract Code, the bidder shall state whether such bidder, or any officer or employee of such bidder who has a proprietary interest in such bidder, has ever been disqualified, removed, or otherwise prevented from bidding on, or completing a Federal, State, or local government project because of a violation of law or a safety regulation; and if so, explain the circumstances.

1. Do you have any disqualification, removal, etc., as described in the above paragraph to declare?

   Yes _____ No _____

2. If yes, explain the circumstances.

_____

_____

_____

_____

_____

_____

_____

_____

Executed on _____, 20__, at _____, California.

I declare, under penalty of perjury, that the foregoing is true and correct.

_____	_____
Signature(s) of Authorized Bidder	Signature(s) of Authorized Bidder
_____	_____
Title	Title

QUESTIONNAIRE REGARDING SUBCONTRACTORS

Bidder shall answer the following questions and submit with the Proposal.

1. Were bid depository or registry services used in obtaining subcontractor bid figures in order to compute your bid? Yes ( )No ( )

2. If the answer to No. 1 is "yes," please forward a copy of the rules of each bid depository you used with this questionnaire.

3. Did you have any source of subcontractors' bids other than bid depositories? Yes ( )No ( )

4. Has any person or group threatened you with subcontractor boycotts, union boycotts, or other sanctions to attempt to convince you to use the services or abide by the rules of one or more bid depositories. Yes ( )No ( )

5. If the answer to No. 4 is "yes," please explain the following details:

   (a) Date: _____

   (b) Name of person or group: _____

   (c) Job involved (if applicable): _____

   (d) Nature of threats: _____

   (e) Additional comments (use additional paper if necessary):
   _____

I declare, under penalty of perjury, that the foregoing is true and correct.

Dated this _____ day of _____, 20__.

_____
Name of Company

By _____

_____
Title

By _____

_____
Title

BIDDER'S STATEMENT OF SUBCONTRACTORS AND MATERIAL FABRICATORS

Without exception, the bidder is required to state the name and address of each subcontractor and the portion of the work which each will do as required by Section 2-3, "Subcontracts," of the Standard Specifications and in conformance with Public Contracts Code, Sections 4100 to 4113, inclusive.

Without limiting the generality of the foregoing, any contractor making a bid or offer to perform the work, shall set forth in the Proposal:

(a) The name and the location of the place of business of each subcontractor who will perform work or labor or render service to the prime contractor in or about the construction of the work or improvement, or a subcontractor licensed by the State of California 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 plans and specifications, in an amount in excess of one-half of one percent (0.5%) of the prime contractor's total bid; and

(b) The portion of the work, which will be done by each subcontractor. The prime contractor shall list only one subcontractor for each portion.

The undersigned submits herewith a list of subcontractors in conformance with the foregoing:

Name under Which Subcontractor is Licensed	License No. & Class	Business Address	Specific Description of Subcontract and Portion of the Work to be Done

Signature of Bidder Date

Signature of Bidder Date

Title

Title

ALL SIGNATURES MUST BE NOTARIZED
(Attach or Affix Executed Acknowledgement Form)

NON-COLLUSION AFFIDAVIT

(Title 23 United States Code Section 112 and
Public Contract Code Section 7106)

To the Camrosa Water District
DISTRICT ENGINEERING

In accordance with Title 23 United States Code Section 112 and Public Contract Code 7106, the bidder declares that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder to any other bidder, or to fix any overhead, profit, or cost element of the bid price, or that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

Name of Bidder	Name of Bidder
Signature of Bidder	Signature of Bidder
	Address of Bidder

ALL SIGNATURES MUST BE NOTARIZED
(Attach or Affix Executed Acknowledgment Form)

EQUAL EMPLOYMENT OPPORTUNITY CERTIFICATE

THE BIDDER'S EXECUTION OF THE SIGNATURE PORTION OF THIS PROPOSAL SHALL ALSO CONSTITUTE AN ENDORSEMENT AND EXECUTION OF THOSE CERTIFICATES, WHICH ARE A PART OF THIS PROPOSAL.

The bidder hereby certifies that the bidder and proposed subcontractor(s), if any, have or have not participated in a previous contract or subcontract subject to the Equal Opportunity Clause, as required by Executive Orders 11246, entitled "Equal Employment Opportunity" as amended by Executive Order 11375, and supplemented by Department of Labor Regulations 41 CFR, Part 60, and that, where required, the bidder has filed with the Joint Reporting Committee, the Director of the Office of Federal Contract Compliance, a Federal Government Contracting or administering agency, or the former President's Committee on Equal Employment Opportunity, all reports due under the applicable filing requirements.

_____
Name of Bidding Company

By_____
Authorized Signature

_____
Title (Typed)

_____
Date

TITLE 49, CODE OF FEDERAL REGULATIONS PART 29
DEBARMENT AND SUSPENSION CERTIFICATION

The bidder under penalty of perjury, certifies that except as noted below, the bidder or any person associated therewith in the capacity of owner, partner, director, officer, or manager:

is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any federal agency;

has not been suspended, debarred, voluntarily excluded, or determined ineligible by any federal agency within the past three (3) years;

does not have a proposed debarment pending; and

has not been indicted, convicted, or had a civil judgment rendered against bidder by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past three (3) years.

If there are any exceptions to this certification, insert the exceptions in the following space.

Exceptions will not necessarily result in denial of award, but will be considered in determining bidder's responsibility. For any exception noted above, indicate below to whom it applies, initiating agency, and dates of action.

The above certification is part of the Proposal. Signing this Proposal on the signature portion thereof shall also constitute signature of this Certification.

Note: Providing false information may result in criminal prosecution or administrative sanctions.

CAMROSA WATER DISTRICT

ENGINEERING DEPARTMENT

DOCUMENTS FOR EXECUTION BY SUCCESSFUL BIDDER

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

SPECIFICATION NO. PW 21-04

LIST OF DOCUMENTS FOR

EXECUTION BY SUCCESSFUL BIDDER

CONTRACT BETWEEN THE CAMROSA WATER DISTRICT
AND _____ FOR
1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS

This CONTRACT is made and entered into in the City of Camarillo on this _____ day of _____, 20__, by and between the CAMROSA WATER DISTRICT, hereinafter referred to as DISTRICT, and _____, a _____, hereinafter referred to as CONTRACTOR. *(type of business entity)*

R E C I T A L S :

WHEREAS, on October 12, 2021, DISTRICT invited bids for 1, 2, 3-TCP Removal Project for Conejo Wells, Specification No. PW 21-04; and

WHEREAS, pursuant to said invitation, CONTRACTOR submitted a Proposal which was accepted by DISTRICT for said project.

NOW, THEREFORE, in consideration of their mutual promises, obligations, and covenants hereinafter contained, the parties hereto agree as follows:

1. **Recitals**. The foregoing recitals are true and correct and are a part of this CONTRACT.

2. **Term**. The term of this CONTRACT shall be from the date this CONTRACT is made and entered, as first written above, and shall be completed no later than three hundred thirty (330) consecutive calendar days after the receipt of the Notice to Proceed.

3. **Incorporation By Reference**. Public Contract Code Section 22300, Specification No. PW 21-04, consisting of 105 pages, and all documents incorporated by reference therein, and CONTRACTOR'S Proposal are hereby incorporated by reference and made a part of this CONTRACT.

4. **Precedence of Contract Documents**. If there is a conflict between or among CONTRACT documents, the document highest in precedence shall control. The precedence shall be:

First:	This Document consisting of six (6) pages excluding paragraph 3
Second:	CONTRACTOR'S Proposal
Third:	Permits from other agencies as may be required by law
Fourth:	Special Provisions
Fifth:	Bid Terms and Conditions
Sixth:	Detailed Plans
Seventh:	Standard Plans
Eighth:	Standard Specifications Modifications
Ninth:	"Standard Specifications for Public Works Construction" (SSPWC)
Tenth:	Reference Specifications

Change orders, supplemental agreements, and approved revisions to plans and specifications become a part of item First.

5. **Obligations of the District**.

A. DISTRICT shall be obligated to pay CONTRACTOR based upon the actual DISTRICT-authorized quantities in place and the unit and/or lump sum prices bid by CONTRACTOR, including but not limited to all labor, material, and equipment, rather than the CONTRACT bid price.

B. DISTRICT shall make regular progress payments to CONTRACTOR within thirty (30) days after mutual concurrence with the unit quantities and/or lump sum items of work satisfactorily performed, subject to applicable retention requirements. In no event shall the total amount paid exceed the CONTRACT bid price of _____ Dollars ($_____) unless otherwise agreed to by the parties in writing.

C. Upon receipt of an invoice for work performed to DISTRICT'S satisfaction, DISTRICT shall make progress payments within thirty (30) days of receipt of invoice. If the work is not performed satisfactorily or the invoice is defective, DISTRICT shall notify CONTRACTOR, in writing, of the reasons within seven (7) days of receipt of invoice. The intent of this Section is to comply with Public Contract Code Section 20104.50.

6. **Obligations of the Contractor**.

A. CONTRACTOR shall perform as required by this CONTRACT. CONTRACTOR also warrants on behalf of itself and all subcontractors engaged for the performance of this CONTRACT that only persons authorized to work in the United States pursuant to the Immigration Reform and Control Act of 1986 and other applicable laws shall be employed in the performance of the work hereunder.

B. The CONTRACTOR shall comply with Labor Code Section 1773.2 and Federal prevailing wage requirements and a copy of the general wage rate list shall be posted at each job site. CONTRACTOR shall obey all Federal, State, local and special district laws, ordinances and regulations. CONTRACTOR agrees to indemnify, defend, and hold DISTRICT harmless from any claim that prevailing wages should have been paid pursuant to this CONTRACT, including federal prevailing wage requirements under the Davis-Bacon Act, if applicable, and shall be liable for the payment of same and any penalties thereon.

7. **Audit**. DISTRICT shall have the option of inspecting and/or auditing all records and other written materials used by CONTRACTOR in preparing its statements to DISTRICT as a condition precedent to any payment to CONTRACTOR.

8. **Hold Harmless and Indemnification**. CONTRACTOR shall defend and provide legal defense with attorney(s) acceptable to DISTRICT, District , indemnify, and hold harmless DISTRICT , its agents, officials, officers, representatives, and employees, from and against all claims, lawsuits, liabilities, or damages of whatever nature arising out of or in connection with, or relating in any manner to any act or omission of CONTRACTOR, its agents, employees, and subcontractors, and employees thereof, pursuant to the performance or non-performance of this CONTRACT. CONTRACTOR shall thoroughly investigate any and all claims and indemnify DISTRICT and do whatever is necessary to protect DISTRICT, its agents, officials, officers, representatives, and employees as to any such claims, lawsuits, liabilities, expenses, or damages arising out of this CONTRACT.

9. **Amendments**. Any amendment, modification, or variation from the terms of this CONTRACT shall be in writing and shall be effective only upon mutual written approval by the Director of Public Works and CONTRACTOR.

10. **Anti-Discrimination**. In the performance of the terms of this CONTRACT, CONTRACTOR shall not engage in, nor permit subcontractors to engage in, discrimination in employment of persons because of the age, race, color, religious creed, sex, sexual orientation, national origin ancestry, physical disability, mental disability, medical condition, or marital status of such persons. Violation of this provision may result in the imposition of penalties referred to in Labor Code Section 1735.

11. **Termination**. If, during the term of this CONTRACT, DISTRICT determines that CONTRACTOR is not faithfully abiding by any term or condition contained herein, DISTRICT may notify CONTRACTOR in writing of such defect or failure to perform. The notice must give to the CONTRACTOR a ten (10) day period of time thereafter in which to perform said work or cure the deficiency. If CONTRACTOR has not performed the work or cured said deficiency within the ten (10) days specified in the notice, such failure shall constitute a breach of this CONTRACT, and DISTRICT may terminate this CONTRACT immediately by written notice to CONTRACTOR to said effect. Thereafter, neither party shall have any further duties, obligations, responsibilities, or rights under this CONTRACT except however, any and all obligations of CONTRACTOR'S surety shall remain in full force and effect, and shall not be extinguished, reduced, or in any manner waived by the termination hereof. In said event, CONTRACTOR shall be entitled to the reasonable value of its services performed from the beginning of the period in which the breach occurs up to the day it received DISTRICT'S Notice of Termination, minus any damages, including liquidated damages if so provided herein, occasioned by such breach. DISTRICT reserves the right to delay any such payment until completion or confirmed abandonment of the project, as may be determined in DISTRICT'S sole discretion, so as to permit a full and complete accounting of costs. In no event, however, shall CONTRACTOR be entitled to receive in excess of the compensation quoted in its bid.

12. **Insurance**. CONTRACTOR shall, prior to commencing performance hereunder, submit proof of all insurance coverage as required by the Specification or other document incorporated in and made a part of this CONTRACT.

13. **Complete Contract**. This CONTRACT shall constitute the complete CONTRACT between the parties hereto. No oral agreement, understanding, or representation not

reduced to writing and specifically incorporated herein shall be of any force or effect, nor shall any such oral agreement, understanding, or representation be binding upon the parties hereto.

14. **Independent Contractor**. It is expressly understood between the parties to this CONTRACT that no employee/employer relationship is intended; CONTRACTOR is an independent contractor.

15. **Time of Performance**. Time is of the essence in this CONTRACT.

16. **Liquidated Damages**. Should CONTRACTOR fail to complete the project, or any part thereof, in the time agreed upon in the CONTRACT or within such extra time as may have been allowed for delays or extensions granted as provided in the CONTRACT, CONTRACTOR shall reimburse DISTRICT for the additional expense and damage for each calendar day that the CONTRACT remains uncompleted after the CONTRACT completion date. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the CONTRACT is the per diem rate of One Thousand Dollars ($1000.00) per calendar day. Such amounts are hereby agreed upon as liquidated damages for the loss to DISTRICT resulting from the failure of CONTRACTOR to complete the project within the allotted time and to the value of the operation of the works dependent thereon.

It is expressly understood and agreed that this amount is a reasonable amount and is established in lieu of damages, which are incapable of calculation at the inception hereof, and this amount is not to be considered in the nature of a penalty. DISTRICT shall have the right to deduct such damages from any amount due, or that may become due to CONTRACTOR, or the amount of such damages shall be due and collectible from CONTRACTOR or CONTRACTOR'S surety.

Progress payments made after the scheduled completion date shall not constitute a waiver of liquidated damages.

17. **Conflict of Interest**. Neither CONTRACTOR nor any employees, agents, or subcontractors of CONTRACTOR who will be assigned to this project, to the best of CONTRACTOR'S knowledge, own any property or interest in properties, business relationships, or sources of income which may be affected by the performance of this CONTRACT. Should one party hereto learn of any such interest, income source, or business relationship, such fact shall immediately be brought to the attention of the other party hereto. If the parties thereupon cannot mutually agree upon a means to eliminate the conflict, DISTRICT may terminate the CONTRACT immediately for non-performance pursuant to Section 11 herein.

18. **Successors and Assigns**. The terms hereof shall be binding upon and inure to the benefit of the successors and assigns of the parties hereto; provided, however, that no party hereto shall assign any of the benefits and burdens hereunder, whether voluntarily or by operation of law, without the prior written consent of the other party, and any such assignment without said consent shall be void.

19. **Authority to Execute Contract**. Both DISTRICT and CONTRACTOR do covenant that each individual executing this CONTRACT on behalf of each party is a person duly authorized and empowered to execute contracts for such party.

20. **Jurisdiction and Venue**. Jurisdiction is in the State of California and venue lies in Ventura County.

21. **Non-Appropriation of Funds.** Payments due and payable to CONTRACTOR for current services are within the current budget and within an available, unexhausted, and unencumbered appropriation of DISTRICT. In the event DISTRICT has not appropriated sufficient funds for payment of CONTRACT services beyond the current fiscal year, this CONTRACT shall cover only those costs incurred up to the conclusion of the current fiscal year.

22. **Notices**. All written notices required by or related to this CONTRACT shall be sent by Certified Mail, Return Receipt Requested, postage prepaid, and addressed as listed below. Neither party to this CONTRACT shall refuse to accept such mail; the parties to this CONTRACT shall promptly inform the other party of any change of address. All notices required by this CONTRACT are effective on the day of receipt, unless otherwise indicated herein. The mailing address of each party to this CONTRACT is as follows:

DISTRICT
Ian Prichard, Assistant General Manager
Engineering Department
7385 Santa Rosa Road
Camarillo, CA 93012

CONTRACTOR
_____
_____
_____
_____
_____

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed the day and year first above written.

Camrosa Water District

By: _____
Tony Stafford
General Manager

_____
(Name of contracting company)

By: _____

Title: _____

By: _____

Title: _____

BOND FOR FAITHFUL PERFORMANCE
BOND NO.

KNOW ALL PERSONS BY THESE PRESENTS:

That we, _____, hereinafter referred to as "Contractor," as principal, and _____

_____,

hereinafter referred to as "Surety," are held and firmly bound unto the Camrosa Water District, Camarillo, California, hereinafter referred to as "District" or "Obligee," in the sum of _____ Dollars ($_____), lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, jointly and severally, firmly by these presents.

The condition of the foregoing obligation is such that:

WHEREAS, Contractor has been awarded and is about to enter into the annexed Contract with the Camrosa Water District for the 1, 2, 3- TCP Removal Project for Conejo Wells, No. PW 21-04, and is required by District to give this bond in connection with the execution of said Contract.

NOW, THEREFORE, if Contractor shall well and truly do and perform all the covenants and obligations of said Contract to be done and performed at the time and in the manner specified herein, then this obligation shall be null and void one (1) year after the date of recordation of a Notice of Completion by District of the completed work; otherwise it shall be and remain in full force and effect, and Surety shall cause the Contract to be fully performed or to pay to Obligee the cost of performing said Contract in an amount not exceeding the said sum above specified, and shall also, in case suit is brought upon this bond, pay to Obligee court costs and a reasonable attorney's fee, to be fixed by the court.

Continued

BOND FOR FAITHFUL PERFORMANCE - Continued

IT IS FURTHER PROVIDED, that any alterations in the work to be done or the material to be furnished shall not in any way release either Contractor or Surety, nor shall any extension of time granted under the provisions of the Contract release either Contractor or Surety, and notice of such alterations or extensions of the Contract is hereby waived by Surety.

WITNESS our hands this _____ day of _____, 20__.

_____
Contractor

By_____

Title_____

By_____

Title_____

_____
Surety

By_____

Title_____

FORM TO ACCOMPANY BOND FOR FAITHFUL PERFORMANCE

STATE OF CALIFORNIA)
COUNTY OF) SS.
CITY OF)

On this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for said County and State, residing therein, duly commissioned and sworn, personally appeared _____, known to be the _____ of _____ and the same person whose name is subscribed to the within instrument as the _____ of said _____ _____, and the said _____ duly acknowledged to me that he/she subscribed the name of _____ thereto as Surety and his/her own name as _____.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year first above written.

_____
Notary Public in and for said
County and State aforesaid

BOND FOR MATERIAL SUPPLIERS AND LABORERS

KNOW ALL PERSONS BY THESE PRESENTS:

That we, _____, hereinafter referred to as "Contractor," as principal, and _____

_____,

hereinafter referred to as "Surety," are held and firmly bound unto the Camrosa Water District, Camarillo, California, hereinafter referred to as "District" or "Obligee," in the sum of _____ Dollars ($_____), lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, jointly and severally, firmly by these presents.

The condition of the foregoing obligation is such that:

WHEREAS, Contractor has been awarded and is about to enter into the annexed Contract with the Camrosa Water District for 1, 2, 3- TCP Removal Project for Conejo Wells and is required by District to give this bond in connection with the execution of said Contract.

NOW, THEREFORE, if Contractor in said Contract, or any subcontractor, fails to pay for any materials, provisions, or its other supplies or items used in, upon, for, or about the performance of the work contracted to be done, or for any work or labor of any kind, or for amounts due under the Unemployment Insurance Code with respect to such work or labor, Surety will pay for the same in an amount not exceeding the sum specified above, and also, in case suit is brought upon this bond, a reasonable attorney's fee to be fixed by the court.

This bond shall inure to the benefit of any and all persons named in Section 3181 of the Civil Code of the State of California.

Continued

BOND FOR MATERIAL SUPPLIERS AND LABORERS - Continued

IT IS FURTHER PROVIDED, that any alterations in the work to be done or the material to be furnished which may be made pursuant to the terms of said Contract shall not in any way release either Contractor or Surety, nor shall any extensions of time granted under the provisions of said Contract release either Contractor or Surety, and notice of such alterations or extensions of said Contract is hereby waived by Surety.

WITNESS our hands this _____ day of _____, 20__.

_____
Contractor

By_____

Title_____

By_____

Title_____

_____
Surety

By_____

Title_____

FORM TO ACCOMPANY BOND FOR MATERIAL SUPPLIERS AND LABORERS

STATE OF CALIFORNIA)
COUNTY OF) SS.
CITY OF)

On this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for said County and State, residing therein, duly commissioned and sworn, personally appeared _____, known to be the _____ of _____ and the same person whose name is subscribed to the within instrument as the _____ of said _____ _____, and the said _____ duly acknowledged to me that he/she subscribed the name of _____ thereto as Surety and his/her own name as _____.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year first above written.

_____
Notary Public in and for said
County and State aforesaid

WORKERS' COMPENSATION INSURANCE CERTIFICATE

Sections 1860 and 1861 of the California Labor Code require every contractor to whom a public works contract is awarded to sign and file with the awarding body the following statement:

> "I am aware of the provisions of Section 3700 of the Labor Code which requires every employer to be insured against liability for Workers' Compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."

By_____

Date: _____ Title_____

By_____

Date: _____ Title_____

CAMROSA WATER DISTRICT

ENGINEERING DEPARTMENT

STANDARD SPECIFICATIONS

FOR

1, 2, 3- TCP Removal Project for Conejo Wells

SPECIFICATION NO. PW 21-04

CAMROSA WATER DISTRICT

STANDARD SPECIFICATIONS

0-1 STANDARD SPECIFICATIONS

Except as hereinafter provided, the provisions of the latest edition of the Standard Specifications for Public Works Construction (SSPWC), and all supplements thereto, prepared and promulgated by the Greenbook Committee of Public Works Standards Inc., formerly the Southern California Chapter of the American Public Works Association and the Associated General Contractors of America, and the following modifications thereto are established as the Standard Specifications for the District. They will be referred to in the Special Provisions as the "Standard Specifications."

0-2 DELETIONS

The following sections of the SSPWC are hereby deleted: 2-2, 2-5.2, 6-6.1, 6-9, 7-3, 7-4, 7-10, 9-3.3, 214, 307, 310-5.6.

0-3 NUMBERING OF SECTIONS

The numbering of sections and subsections in these modifications are compatible with the numbering in the SSPWC. The Special Provisions will be numbered as Sections 700 through 799.

The replacement sections of those sections deleted from the SSPWC shall have the same numbers as the sections they replaced.

0-4 ADDITIONS

The sections which follow either replace sections of like number in the SSPWC, which were deleted in Section 0-2 above, or add material not in the SSPWC.

SECTION 1 – TERMS, DEFINITIONS, ABBREVIATIONS AND SYMBOLS

1-2 DEFINITIONS

1-2.1 Additional Definitions

Acceptance – The formal written acceptance by the District of the completed project.

Addendum – A notice issued to all prospective bidders during the bidding period when the modification of the plans and/or specifications necessary to change, correct, clarify or further define any aspect of the work.

Agency/District – Camrosa Water District.

Approved Equal – or words of the like import refer to a material which has been approved by the District Engineer as similar and equal in all respects and acceptable for use in lieu

of the particular materials as specified herein. No "approved equal" material shall be used in any of the work unless approval to use same is first obtained in writing from the District Engineer. The District reserves the right to reject any and all materials, either before or after installation that are not as specified or approved by the District Engineer in writing. In all cases where propriety articles are specified, it is the intent of these specifications to permit the use of approved equals, unless specifically prohibited. Requests for "approved equal" status for proposed substitutions shall be submitted within fifteen (15) days after the award of the Contract. Such requests shall include substantiating data and the proposed credit to the Contract price for the use of such substitution, should it be approved.

Approved, Required, Directed – or words of similar import, refer to and indicate that the work or materials shall be "approved," "required," or "directed" by the Camrosa Water District or its duly authorized representative.

Bid – That document included in the Proposal setting forth the performance prices for the work.

Board of Directors – The body constituting the awarding authority of the District.

Department – Engineering Department of Camrosa Water District.

Due Notice – A written notification, given in due time, of a proposed action where such notification is required by the Contract to be given a specified interval of time (usually 48-hours or two working days) prior to the commencement of the contemplated action. Notifications may be from District to Contractor or from Contractor to District.

Engineer – The District Engineer of the Camrosa Water District.

Laboratory - Any laboratory of a public agency or any recognized commercial testing laboratory approved by the District.

Prompt – The briefest interval of time required for a considered reply, including the time required for approval by a governing body.

Proposal – Includes all those documents, which must be submitted by bidder in order to be awarded the Contract.

1-3 ABBREVIATIONS

1-3.3.1 Institutions

AAN	American Association of Nurserymen
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AISC	American Institute of Steel Construction
APCD	Air Pollution Control District
APWA	American Public Works Association

ASA	American Standards Association
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
CAL-OSHA	California Occupational Safety & Health Administration
CITY	City of Camarillo
CRSI	Concrete Reinforcing Steel Institute
DISTRICT	Camrosa Water District
IEEE	Institute of Electric and Electronic Engineer
NEC	National Electrical Code
NFPA	National Fire Protection Association
RSRPD	Rancho Simi Recreation and Parks District
SSPWC	Standard Specifications for Public Works Construction, latest edition, prepared by the Greenbook Committee of Public Works Standards, Inc., formerly the Southern California Chapters of AGC and APWA
SSS	State of California, Department of Transportation, Standard Specifications, latest edition
VCFCD	Ventura County Flood Control District
VCTC	Ventura County Transportation Commission

SECTION 2 – SCOPE AND CONTROL OF THE WORK

2-2 CONTRACT ASSIGNMENT

The bidder shall not in whole or in part, assign, transfer, convey, or otherwise dispose of the Contract, or its right, title or interest, or its power to execute such a contract to any individual or business entity of any kind without the previous written consent of the District.

2-5 PLANS AND SPECIFICATIONS

2-5.1.1 Accuracy of Specifications

The specifications and the plans for this project are believed by the District to be accurate and to contain no misrepresentation or any concealment of any material fact. Bidders are cautioned to undertake an independent analysis of any materials, test data and results, if any, in the specifications. District does not guarantee the accuracy of any interpretations of test data and results contained in the specifications. Bidder and all subcontractors named in the Proposal shall bear sole responsibility for bid errors resulting from misstatements or omissions in the plans and specifications which would have been ascertained by examining either the project site or the test data and results, if any, in the District's possession.

Although the effect of ambiguities or defects in the plans and specifications will be as determined by law, any patent ambiguity or defect shall give rise to a duty of the bidder to inquire prior to bid submission. Failure to so inquire shall cause any such ambiguity to be construed against the bidder and/or a waiver of any defect by the bidder.

An ambiguity or defect shall be considered patent if it is of such a nature that the bidder assuming reasonable skill, ability, and diligence, knew or should have known of the existence of the ambiguity or defect. Furthermore, failure of the bidder or subcontractors to notify District in writing of bid specifications or plans defects or ambiguities prior to bid submission shall waive any right to assert said defects or ambiguities subsequent to submission of the bid.

To the extent that these specifications constitute performance specifications, the District shall not be liable for costs incurred by the successful bidder to achieve the project's objective or standard beyond the amounts provided therefor in the bid.

In the event that any dispute arises after awarding the bid as a result of any actual or alleged ambiguity or defect in the plans and/or specifications, or over any other matter whatsoever, Contractor shall immediately notify District in writing. Contractor and all subcontractors shall continue to perform whether or not the ambiguity or defect is major, material, minor, or trivial, and whether or not a change order, time extension, or additional compensation has been granted by the District. Failure to provide such written notice within one working day of Contractor becoming aware of the facts giving rise to the dispute shall constitute a waiver of the right to assert the causative role of the defect or ambiguity in the plans or specifications concerning the dispute.

2-5.4 Bidders Required to Make Investigations

Bidders are required to make their own investigations and their own estimates of the site. It is not intended nor to be inferred that the specifications are or constitute any representation of warranty, express or implied, by the Camrosa Water District or any officer or employee, thereof, that any conditions which may seem to be indicated by the specifications actually exist or are to be relied upon either with reference to site or subsoil conditions, the presence or absence of groundwater, or otherwise. The bidder to whom this Contract is awarded covenants and agrees by execution of the Contract that the specifications do not constitute any warranty or representation, express or implied, respecting actual conditions which will be encountered by the Contractor in performance of the Contract and that the Contractor cannot and does not rely thereon and shall not be relieved of liability under the Contract. Neither the District nor any officer or employee thereof shall be liable to the Contractor as a result of any difference or variance between conditions suggested or seemingly indicated by the specifications of the work or otherwise. It is the overriding purpose and intent of the parties that the Contractor assumes all risks in connection with performance of the work in accordance with the Contract documents regardless of any such difference or variance. The Contractor forever and irrevocably waives, relinquishes, and releases any claims, rights, demands, damages, actions, and causes of action in connection therewith against the Camrosa Water District and its officers and employees.

2-5.5 Additional Investigations Required

Prior to bid submittal, the bidder must perform an independent site investigation and by the bid represents that the bidder has accomplished and is satisfied as to the result of the

investigation required under these Bid Terms and Conditions. In addition thereto, the bidder has investigated all other general and local conditions pertaining to the work to be performed, the site of the work and adjacent and nearby areas, including, but not limited to, those relating to transportation, the disposal, handling and storage of materials, availability of labor, water, electrical power, road and uncertainties of weather, all other physical conditions at and near the site of the work to be performed by the contractor, including the conformation and conditions of the ground, and the character of equipment and facilities needed prior to and during prosecution of the work. The bidder to whom this Contract is awarded covenants and agrees by execution of the Contract that the Contractor neither has nor shall have any claim, demand, action, or cause of action against the Camrosa Water District, or any officer or employee thereof, on account of or in respect to any such conditions, whether or not the same are ascertained or known by the Contractor. It is the sole responsibility of the Contractor to estimate properly the difficulties to be encountered in providing necessary labor, quantities of material, and the cost of successfully performing the Contractor's work in conformity with the Contract documents. Neither the Camrosa Water District nor any officer or employee thereof shall be responsible to the Contractor, nor shall any claim, demand, action or cause of action exist or arise in favor of the Contractor, on account of any oral statement or alleged representation made by the Camrosa Water District, or any officer or employee thereof, in respect to any of the foregoing matters.

SECTION 5 – UTILITIES

5-7 SCOPE OF WORK

Work shall conform to the provisions in Section 5 of the SSPWC. Manhole covers, water valve covers and grates of existing facilities will be adjusted to grade by the respective utility companies if such facilities are not included in the Contract. The Contractor shall cover grates with material suitable for preventing any paving material from passing through the grate. The Contractor shall mark the location of all existing covers by inscribing a cross in the new pavement or overlay. The cross mark shall be clear and legible after final rolling.

The Contractor shall remove extraneous material from the interior and exterior of manholes, valve boxes, storm drains, gutters, or other facilities. Covers, which are partially exposed, shall be cleaned to the satisfaction of the Engineer.

Immediately prior to placing asphalt emulsion, the Contractor shall wrap all utility covers in a three (3) mm plastic bag. The Contractor shall take care not to allow asphalt emulsion to run onto the covers. Diesel fuel application to the covers will not be allowed.

The Contractor shall contact the respective utility companies and other agencies listed below forty-eight (48) hours prior to starting any work on each road by which those companies are affected. To ensure that all utility companies are aware of the proposed work, the Contractor shall notify the Underground Service Alert Office (South USA) by calling 1-800-422-4133 at least two (2) working days prior to the start of any resurfacing work.

If the Contractor, while performing work pursuant to the Contract, discovers utility facilities not identified correctly or omitted in the Plans or Specifications by the District, the Contractor shall immediately notify the District and utility owner in writing.

Payment for costs incurred in protecting utility vaults, manholes, valve boxes, including the requirements pursuant to this section, shall be included in the prices bid for other items of work and no additional compensation will be allowed therefor.

UTILITY/AGENCIES TELEPHONE CONTACT LIST

CITY ENGINEER
(805) 583-6786

TRAFFIC ENGINEER
(805) 583-6786

CITY POLICE DEPARTMENT
(805) 583-6950

CALIFORNIA HIGHWAY PATROL
(805) 654-4710 (4571)

VENTURA COUNTY SHERIFF
(805) 494-8200

SIMI VALLEY TRANSIT DIVISION
(805) 583-6456

CAMROSA WATER DISTRICT
(805) 482-8063

CALLEGUAS MUNICIPAL WATER DISTRICT
(805) 526-9323

EDISON INTERNATIONAL COMPANY
(805) 494-7066

SOUTHERN CALIFORNIA GAS CO.
(818) 701-3468

MED TRANS AMBULANCE
(805) 495-4666

TIME WARNER
(805) 477-4439

AT&T TELEPHONE
(805) 583-6640

EQUILON CORPORATION
(310) 816-2063

CONOCO-PHILLIPS
(805) 525-6312

UNDERGROUND SERVICE ALERT
1-800-422-4133 OR 811

SOUTHERN PACIFIC TRANSPORTATION CO.
(800) 336-9193

VENTURA COUNTY FIRE DEPARTMENT
(805) 389-9738, ext. 1

U.S. POST OFFICE
(805) 526-9189 OR (800) 275-8777

AMERICAN RUBBISH/GI RUBBISH
(805) 522-9400 EXT. 4360

ANDERSON RUBBISH
(805) 520-6656

VERIZON
800-624-9675

QWEST
800-283-4237

SECTION 6 - PROSECUTION, PROGRESS, AND ACCEPTANCE OF THE WORK

6-3.3 Temporary Suspension of Work

If suspension of work is ordered, Contractor shall do all the work necessary to provide a safe, smooth, and unobstructed passageway through the construction for use by public traffic during the period of such suspension. In the event that the Contractor fails to perform the work above specified, the District will perform such work and the cost thereof will be deducted from monies due or to become due the Contractor.

If the Engineer orders a suspension of all of the work or a portion of the work, due to unsuitable weather or to such other conditions as are considered unfavorable to the suitable prosecution of the work, the days on which the suspension is in effect shall not be considered working days.

If a portion of work at the time of such suspension is not a current controlling operation or operations, but subsequently does become the current controlling operation or operations, the determination of working days will be made on the basis of the then current controlling operation or operations.

If a suspension of work is ordered by the Engineer due to the failure on the part of the Contractor to carry out orders given or to perform any provision of the Contract, the days on which the suspension order is in effect shall be considered working days if such days are working days.

6-6.1 Work Delay

If the Contractor is obstructed or delayed in the work required to be done hereunder by changes in the work or by any default, act, or omission of the District, or by strikes, or by fire, earthquake, or any other act of God, or by the inability to obtain materials, equipment, or labor due to Federal Government restrictions arising out of defense or war programs, then the time of completion may, at the District's sole option, be extended for such periods as may be agreed upon by the District and the Contractor.

6-8.1 No Waiver of Legal Rights

The District shall not be precluded or be stopped by any measurement, estimate, or certificate made either before or after the completion and acceptance of the work and payment therefor from showing the true amount and character of the work performed and materials furnished by the Contractor, nor from showing that any such measurement, estimate, or certificate is untrue or is incorrectly made, nor that the work or materials do not in fact conform to the Contract.

The District shall not be precluded or stopped, notwithstanding any such measurement, estimate, or certificate and payment in accordance therewith, from recovering from the Contractor or Surety, or both, for such damage as it may sustain by reason of the Contractor's failure to comply with the terms of the Contract.

Neither the acceptance by the Engineer or by the Engineer's representative nor any payment for or acceptance of the whole or any part of the work, nor any extension of time, nor any possession taken by the Engineer shall operate as a waiver of any portion of the Contract or of any power herein reserved or of any right to damages.

A waiver of any breach of the Contract shall not be held to be a continuing waiver or a waiver of any other or subsequent breach.

6-8.2 Non-Complying Work

Neither the final payment nor any provision in the Contract documents, nor partial or entire occupancy of the premises by the District, nor recordation of Notice of Completion by District shall constitute an acceptance of work not done in accordance with the Contract documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship.

SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

7-2.2.1 Labor Laws

Labor Code Concerning Forfeiture for Worker Required to Work Excess Hours

As provided in Section 1810 of the Labor Code, eight (8) hours shall constitute a legal day's work, and as required by Section 1813 of the Labor Code, the Contractor shall, as a penalty, forfeit to the District Twenty-Five Dollars ($25.00) for each worker employed in the execution of the Contract by the Contractor or by any subcontractor for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one calendar day or forty (40) hours in any one (1) calendar week.

Exception: Pursuant to Labor Code Section 1815, work performed by employees of the Contractor and subcontractors in excess of eight (8) hours per day or forty (40) hours during any one week shall be permitted upon compensation for all hours worked in excess of eight (8) hours per day at not less than one and one-half (1-1/2) times the basic rate of pay.

Labor Code Concerning Forfeiture for Paying Less than Prevailing Wage Rate

The Contractor shall comply with Division 2, Part 7, Chapter 1 of the California Labor Code and shall pay prevailing wage rates. In accordance with Section 1775 and subsequent amendments of the Labor Code, the Contractor shall forfeit as a penalty to the Camrosa Water District, not more than Fifty Dollars ($50.00) for each calendar day or portion thereof, for each worker paid less than the stipulated prevailing rates for such work or craft in which such worker is employed for any work done under the Contract by the Contractor or by any subcontractor in violation of the provisions of said California Labor Code. In addition to said penalty and pursuant to the said Section 1775 and subsequent amendments, the difference between the stipulated

prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the stipulated prevailing wage rate shall be paid to each worker by the Contractor. Any sums forfeited under the provisions of this section will be deducted from the payments under this Contract by the Camrosa Water District.

Attention is directed to Section 1735 of the Labor Code, which reads as follows:

> "A contractor shall not discriminate in the employment of persons upon public works on any basis listed in Subdivision (a) of Section 12940 of the Government Code, as those bases are defined in Sections 12926 and 12926.1 of the Government Code, except as provided in Section 19240 of the Government Code. Every contractor for public works who violates this section is subject to all the penalties imposed for a violation of this chapter."

Attention is also directed to the requirements of the California Fair Employment and Housing Act (Government Code Sections 12900 through 12996 - Stat. 1980, Chapter 992), to the regulations promulgated by the Fair Employment and Housing Commission to implement said Act, and to the nondiscrimination, affirmative action and equal employment opportunity requirements of these Specifications.

The Contractor or subcontractor shall comply with the Copeland "Anti-Kick Back" Act (18 U.S.C. 874) as supplemented in the Department of Labor regulations (29 CFR, Part 3). This act provides that each Contractor or subcontractor shall not induce, by any means, any person employed in the construction, completion, or repair of public works, to give up any part of the compensation due that person. Any suspected or reported violation will be reported to the appropriate Federal Agency for proper action.

Attention is directed to the provisions in Sections 1777.5 and 1777.6 of the Labor Code concerning the employment of apprentices by the Contractor or any subcontractor.

The Contractor shall comply with the General Prevailing Wage determination made by the Director of Industrial Relations, pursuant to California Labor Code, Division 2, Part 7, Chapter 1, Article 2.

Section 1777.5 requires the Contractor and subcontractors employing tradesmen in any apprenticeable occupation to apply to the joint apprenticeship committee nearest the site of the public works project and which committee administers the apprenticeship program in that trade for a certificate of approval. The certificate will also fix the hourly non-overtime ratio of apprentices to journeymen that will be used in the performance of the Contract; except for Land Surveyors in which case the ratio shall be not less than one (1) apprentice for each five (5) journeyman. The hourly non-overtime ratio of apprentices to journeymen in such cases shall not be less than one (1) to five (5), if practicable, except:

a) When unemployment in the area of coverage by the joint apprenticeship committee has exceeded an average of fifteen percent (15%) in the ninety (90) days prior to the request for certificate; or

b) When the number of apprentices in training in the area exceeds a ratio of one (1) to five (5); or

c) When the trade can show that it is replacing at least one-thirtieth (1/30th) of its membership through apprenticeship training on an annual basis state-wide or locally; or

d) If assignment of an apprentice to any work performed under a public works contract would create a condition which would jeopardize his/her life or the life, safety or property of fellow employees or the public at large, or if the specific task to which the apprentice is to be assigned is of such a nature that training cannot be provided by a journeyman; or

e) When contracts of general contractors or specialty contractors not bidding for work through a general or prime contractor when the contracts involve less than Thirty Thousand Dollars ($30,000).

The Contractor is required to make contributions to funds established for the administration of apprenticeship programs if the Contractor employs registered apprentices or journeymen in any apprenticeable trade on the Contract and if subcontractors on the public works site are making such contributions.

Information relative to apprenticeship standards, wage schedules, and other requirements may be obtained from the Director of Industrial Relations, Administrator of Apprenticeship, San Francisco, California, or from the Division of Apprenticeship Standards and its branch offices.

7-3 LIABILITY INSURANCE

Insurance - The Contractor shall meet the following provisions (Sections 1 through 7) relating to insurance coverage:

1. General Conditions - Without limiting the Contractor's indemnification of District, Contractor shall provide and maintain at its own expense the insurance listed under Section 7 (Evidence of Coverage) covering its operations, subject to the following conditions:

   a) The District and its boards, officers, agents, and employees shall be included as additional insureds in all liability insurance policies and endorsements thereto except for workers' compensation and professional errors and omissions. The District shall be named loss payee as its interest may appear in all property insurance.

b) In carrying out his/her work, the Contractor shall at all times exercise all necessary precautions for the safety of employees appropriate to the nature of the work and the conditions under which the work is to be performed, and be in compliance with all applicable federal, state and local statutory and regulatory requirements including California Department of Industrial Relations (Cal/OSHA) regulations; and the U.S. Department of Transportation Omnibus Transportation Employee Testing Act. Safety precautions, as applicable, shall include but shall not be limited to: adequate life protection and lifesaving equipment; adequate illumination; instructions in accident prevention for all employees, such as the use of machinery guards, safe walkways, scaffolds, ladders, bridges, gang planks, confined space procedures, trenching and shoring, fall protection, and other safety devices; equipment and wearing apparel as are necessary or lawfully required to prevent accidents, injuries, or illnesses; and adequate facilities for the proper inspection and maintenance of all safety measures.

c) The Contractor shall be responsible for the safeguarding of all utilities. At least two working days before beginning work, the Contractor shall call the Underground Service Alert (USA) in order to determine the location of sub-structures. The Contractor shall immediately notify Camrosa and the utility owner if he/she disturbs, disconnects, or damages any utility.

d) In accordance with Section 6705 of the California Labor Code, the Contractor shall submit to the Camrosa specific plans to show details of provisions for worker protection from caving ground during excavations of trenches of five feet or more in depth. The excavation/trench safety plan shall be submitted to and accepted by the Camrosa prior to starting excavation. The trench safety plan shall have details showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground. If such a plan varies from the shoring system standards established by the Construction Safety Orders of the California Department of Industrial Relations (Cal/OSHA), the plan shall be prepared by a California registered civil or structural engineer. As part of the plan, a note shall be included stating that the registered civil or structural engineer certifies that the plan complies with the Cal/OSHA Construction Safety Orders, or that the registered civil or structural engineer certifies that the plan is not less effective than the shoring, bracing, sloping or other provisions of the Safety Orders. In no event shall the Contractor use a shoring, sloping, or protective system less effective than that required by said Construction Safety Orders. Submission of this plan in no way relieves the Contractor of the requirement to maintain safety in all areas. If excavations or trench work requiring a Cal/OSHA permit are to be undertaken, the Contractor shall submit his/her permit with the excavation/trench work safety plan to the Camrosa before work begins.

e) Any deductible or self-insured retention must be declared to and approved by the Camrosa. At the option of Camrosa, the insurer shall either reduce or eliminate such deductibles or self-insured retentions.

f) Insurance is to be placed with insurers having a current A.M. Best rating of no less than A:VII or equivalent or as otherwise approved by Camrosa.

g) In the event that the Contractor employs other contractors (sub-contractors) as part of the work covered by this agreement, it shall be the Contractor's responsibility to require and confirm that each sub-contractor meets the minimum insurance requirements specified above.

h) The Contractor shall provide and maintain builder's risk insurance (or installation floater) covering all risks of direct physical loss, damage or destruction to the work in the amount specified in this section, to insure against such losses until final acceptance of the work by Camrosa. Such insurance shall insure at least against the perils of fire and extended coverage, theft, vandalism and malicious mischief, and collapse. Camrosa, its directors, officers, employees, and authorized volunteers shall be named insured on any such policy. The making of progress payments to the Contractor shall not be construed as creating an insurable interest by of for Camrosa or be construed as relieving the Contractor or their subcontractors of responsibility for loss from any direct physical loss, damage or destruction occurring prior to final acceptance of the work by Camrosa.

i) Such insurance shall be primary with respect to any insurance maintained by District and shall not call on District's insurance for contributions.

j) With respect to the interests of the District, the Contractor's insurance shall not be canceled nor reduced in coverage or limits until after thirty (30) days written notice shall have been sent by certified mail, return receipt requested, to the District, 7385 Santa Rosa Road, Camarillo, California 93012, and shall contain an unequivocal clause so stating.

k) A District approved endorsement or certified copy of insurance policies providing coverage shall be submitted to and approved by the District's Business Manager prior to commencement of any work or tenancy. If a general aggregate limit applies, either the general aggregate limit shall apply separately to this project/location (coverage as broad as the ISO CG 25 03 or ISO CG 25 04 endorsement provided to Camrosa or the general aggregate limit shall be twice the required occurrence limit.

2. Workers' Compensation - The Contractor shall procure and maintain during the life of the contract workers' compensation insurance or a valid certificate of consent to self-insure for all its employees engaged on or at the site of the project. In case any of the work is sublet, the Contractor shall require all subcontractors to similarly provide workers' compensation insurance for all the latter's employees unless such employees are covered by protection afforded by workers' compensation insurance carried by the Contractor.

The Contractor and all sub-contractors shall insure (or be a qualified self-insured) under the applicable laws relating to workers' compensation insurance, all of their employees working on or about the construction site, in accordance with the

"Workers' Compensation and Insurance Act", Division IV of the Labor Code of the State of California and any Acts amendatory thereof. The Contractor shall provide employer's liability insurance with limits of no less than $1,000,000 each accident, $1,000,000 disease policy limit, and $1,000,000 disease each employee.

By submitting a bid pursuant to these specifications, Contractor hereby certifies that it is aware of the provisions of Section 3700 et seq., of the Labor Code which require every employer to be insured against liability for Workers' Compensation.

3. Aggregate Limits/Blanket Coverage - If any of the required insurance coverage contain aggregate limits or apply to other operations or tenancy of the Contractor outside these specifications, Contractor shall give District prompt, written notice of any incident, occurrence, claim, settlement or judgment against that insurance which may diminish the protection that such insurance affords the District. Contractor shall further take immediate steps restoring such aggregate limits or shall provide other insurance protection for such aggregate limits.

4. Modification of Coverage - The District reserves the right at any time during the term of any contract executed with the Contractor pursuant to these specifications (Contract) to change the amounts and types of insurance required hereunder by giving Contractor ninety (90) days written notice. If such change results in a premium increase in excess of ten percent (10%) to Contractor, District agrees to negotiate additional compensation proportional to the increased benefit to the District.

5. Failure to Procure or Maintain Insurance - Contractor's failure to procure or maintain required insurance program shall constitute a material breach of contract under which the District may immediately terminate the Contract or, at its discretion, procure or renew such insurance to protect the District's interests and pay any and all premiums in connection therewith, and recover all monies so paid from Contractor, or deduct all monies so paid from payments due Contractor.

6. Underlying Insurance - Contractor shall be responsible for requiring indemnification from its employees receiving mileage allowance, consultants, agents, and subcontractors, if any, to protect the District's interests and shall be responsible for ensuring that such persons comply with any applicable insurance statutes. Contractor is encouraged to seek professional advice in this regard.

7. Evidence of Coverage - Evidence of coverage (as checked below) having as a minimum the limits shown must be submitted and approved prior to commencement of work or any tenancy. Amounts shown are Combined Single Limit (CSL). Split limits may be substituted if the total per occurrence equals or exceeds the CSL amount.

	Description	Limits
X	Workers' Compensation	Statutory
	(X) Employer's Liability	$1,000,000

(X) Waiver of Subrogation

X	General Liability (must be written on an Occurrence Form)	$5,000,000 CSL

(X) Premises and Operations
(X) Contractual Liability
(X) Independent Contractors
(X) Products/Completed Operations
(X) Broad Form Property Damage
(X) Personal Injury
(X) Broad Form Liability Endorsement
(X) Explosion Hazard
(X) Collapse/Underground Hazard

X	Automobile Liability (must be written on an Occurrence Form)	$2,000,000 CSL

(X) Owned Automobiles
(X) Nonowned/Hired Automobiles
( ) Garagekeeper's Legal Liability

X	Property Insurance	Value of Structure

(X) All Risk Coverage

7-4 HOLD HARMLESS

1. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless and defend Camrosa, its directors, officers, employees, or authorized volunteers, and each of them from and against:
   a. Any and all claims, demands, causes of action, damages, costs, expenses, losses or liabilities, in law or in equity, of every kind or nature whatsoever for, but not limited to, injury to or death of any person including Camrosa and/or Contractor, or any directors, officers, employees, or authorized volunteers of Camrosa or Contractor, and damages to or destruction of property of any person, including but not limited to, Camrosa and/or Contractor or their directors, officers, employees, or authorized volunteers, arising out of or in any manner directly or indirectly connected with the work to be performed under this agreement, however caused, regardless of any negligence of Camrosa or its directors, officers, employees, or authorized volunteers, except the sole negligence or willful misconduct or active negligence of Camrosa or its directors, officers, employees, or authorized volunteers;

   b. Any and all actions, proceedings, damages, costs, expenses, penalties or liabilities, in law or equity, of every kind or nature whatsoever, arising out of , resulting from, or on account of the violation of any governmental law or regulation, compliance with which is the responsibility of Contractor,

c. Any and all losses, expenses, damages (including damages to the work itself), attorneys' fees, and other costs, including all costs of defense, which any of them may incur with respect to the failure, neglect, or refusal of Contractor to faithfully perform the work and all of the Contractor's obligations under the agreement. Such costs, expenses, and damages shall include all costs, including attorneys' fees, incurred by the indemnified parties in any lawsuit to which they are a party

2. Contractor shall defend, at Contractor's own cost, expense and risk, any and all such aforesaid suits, actions, or other legal proceedings of every kind that may be brought or instituted against Camrosa or its directors, officers, employees, or authorized volunteers.

3. Contractor shall pay and satisfy any judgment, award or decree that may be rendered against Camrosa or its directors, officers, employees, or authorized volunteers, in any and all such suits, actions, or other legal proceedings.

4. Contractor shall reimburse Camrosa or its directors, officers, employees, or authorized volunteers, for any and all legal expenses and costs incurred by each of them in connection therewith or in enforcing the indemnity herein provided.

5. Contractor's obligation to indemnify shall not be restricted to insurance proceeds, if any, received by the Camrosa, or its directors, officers, employees, or authorized volunteers

7-5 PERMITS

7-5.1 County of Ventura Encroachment Permit

A County of Ventura Encroachment Permit may be required to work within public right-of-way and will be issued at no cost to the Contractor. The Contractor shall adhere to all of the requirements of the issued encroachment permit. Where there are differences between the encroachment permit requirements and requirements otherwise specified in the Specifications, the stricter of the two shall apply unless otherwise allowed by the Owner in writing.

7-5.2 Caltrans Encroachment Permit

When work is proposed within State of California Department of Transportation right-of-way, the District will obtain an Encroachment Permit. However, after contract award, the Contractor shall obtain and pay for an Encroachment Permit Rider at the State of California Department of Transportation, Permit Section, 120 S. Spring Street, Los Angeles, CA 90012. The Contractor will need to show evidence of possessing bonding that meets the requirements of the State of California Department of Transportation. Such bonding costs will be at Contractor's expense.

7-5.3 Other Encroachment Permits

When work occurs in the right-of-way of other entities, the Contractor shall obtain and pay, as required, for an encroachment permit from that entity.

7-6 PROJECT SITE MAINTENANCE

7-6.2.1 Additional Air Pollution Control Requirement

The Contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act of 1970 (42 U.S.C. 7401 et. seq.) as amended. Violations will be reported to the appropriate authorities.

7-6.8 Sound Control Requirements

The Contractor shall comply with all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the Contract.

Each internal combustion engine used for any purpose on the job or related to the job shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without such muffler.

The noise level from the Contractor's operations, between the hours of 9:00 p.m. and 7:00 a.m., shall not exceed a maximum of fifty (50) dba at a distance of fifty (50) feet from the source. This requirement in no way relieves the Contractor from responsibility for complying with local ordinances regulating the noise level.

Said noise level requirement 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 the Contractor. The use of loud signals shall be avoided in favor of light warnings except those required by safety laws 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 therefor.

7-7 PAYROLL RECORDS

7-7.1 Payroll Documentation

The Contractor's attention is directed to the following provisions of Labor Code Section 1776. The Contractor shall be responsible for compliance with these provisions, including compliance by subcontractors.

(a) The Contractor and each subcontractor shall keep an accurate payroll record, showing the name, address, social security number, work classification, and straight time and overtime hours worked each day and week, and the actual per diem wages paid to

each journeyman, apprentice, worker, or other employee employed in connection with the public work.

(b) The payroll records required under subsection (a) shall be certified and shall be available for inspection at all reasonable hours at the principal office of the Contractor on the following basis:

(1) A certified copy of an employee's payroll record shall be made available for inspection or furnished to such employee or authorized representative on request.

(2) A certified copy of all payroll records required in subsection (a) shall be made available for inspection or furnished upon request to a representative of the City, the Division of Labor Standards Enforcement and the Division of Apprenticeship Standards of the Department of Industrial Relations.

(3) A certified copy of all payroll records required in subsection (a) or copies thereof shall be made available upon request to the public for inspection. However, a request by the public shall be made through the District, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement. If the requested payroll records have not been provided pursuant to subsection (2), the requesting party shall, prior to being provided the records, reimburse the Contractor, subcontractor, or the entity through which the request was made, the costs of preparation of the requested documents. The public shall not be given access to such records at the principal office of the Contractor.

(c) The certified payroll records shall be on forms provided by the Division of Labor Standards Enforcement or shall contain the sample information as the forms provided by the Division.

(d) The Contractor shall file a certified copy of the records required in subsection (a) with the entity that requested such records within ten (10) days after receipt of a written request.

(e) Any copy of records made available for inspection and furnished upon request to the public or any public agency by the District, the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address, and social security number. The name and address of the Contractor awarded the Contract or performing the Contract shall not be marked or obliterated.

(f) The Contractor shall inform the District of the location of the records required under subsection (a), including the street address, city, and county, and shall, within five (5) working days, provide the District a notice of a change of location and address.

(g) In the event of noncompliance with the requirements of this section, the Contractor shall have ten (10) calendar days in which to comply with this section. Should noncompliance still exist after such ten (10) day period, the Contractor shall, as a

penalty to the state or political subdivision on whose behalf the Contract is made or awarded, forfeit Twenty-Five Dollars ($25.00) for each calendar day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement, these penalties shall be withheld from progress payments then due.

LIST OF APPENDICES

APPENDIX A

APPENDIX A

Release on Contract

RELEASE ON CONTRACT

PROJECT NAME: 1, 2, 3- TCP Removal Project for Conejo Wells

SPECIFICATION NO.: PW 21-04

WHEREAS, by the terms of the Contract dated _____, entered into by the Camrosa Water District and the undersigned, the Contractor agreed to perform certain work for the compensation specified in said Contract; and

WHEREAS, the Contractor represents that said work is fully completed and that final payment is due to the Contractor under terms of said Contract,

NOW, THEREFORE, in consideration of the promises and the payment by the Camrosa Water District to the Contractor of the amount due under the Contract, to wit, the sum of _____ Dollars ($_____), and the additional consideration of One Dollar ($1.00), receipt of which is hereby acknowledged by the Contractor, the Contractor hereby releases and forever discharges the Camrosa Water District of and from all manner of debts, dues, demands, sum or sums of money, accounts, claims, and causes of action, in law and in equity, under or by virtue of said Contract, except as follows (if none, leave blank): _____

_____.

IN WITNESS WHEREOF, the hand and seal of the Contractor have been hereunto set this _____ day of _____, 2021.

This form must be notarized using proper acknowledgment form (see Civil Code Sections 1189, 1190, and 1190a).

_____
Contractor

By _____

Title _____

By _____

Title _____

CONTRACTOR'S AFFIDAVIT OF PAYMENT

PROJECT NAME: 1, 2, 3- TCP Removal Project for Conejo Wells

SPECIFICATION NO.: PW 21-04

DATE:_____

The undersigned hereby certifies that all workers, and persons employed, all firms supplying materials, and all subcontractors working on the above named project have been paid in full, and there are no bills, invoices, or obligations outstanding against the project for either labor, materials, or equipment furnished except for the following disputed claims for which Notices to Withhold have been filed under the provisions of the Code of Civil Procedure: (If none, leave blank) _____

_____

_____.

IN WITNESS WHEREOF, the hand and seal of the Contractor have been hereunto set this _____ day of _____, 2021.

This form must be notarized using proper acknowledgment form (see Civil Code Sections 1189 and 1190).

_____
Contractor Name:

By: _____
Signature of Authorized Representative

Title: _____

By: _____
Signature of Authorized Representative

Title: _____

CAMROSA WATER DISTRICT

CONTRACT DOCUMENTS

AND

SPECIFICATIONS

FOR THE

1,2,3-TCP REMOVAL PROJECT

OCTOBER 2021

Prepared for:

CAMROSA WATER DISTRICT
7385 Santa Rosa Road
Camarillo, CA 93012

Prepared by:

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

REGISTERED PROFESSIONAL ENGINEER
RONALD KEVIN BERRYHILL
No. 70415
Civil
STATE OF CALIFORNIA

DATE SIGNED 10/12/2021

455 W FIR AVE
CLOVIS, CALIFORNIA 93611-0242
559/449-2700 FAX 559/449-2715

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SECTION 00 01 10

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DIVISION 43 - Process Gas and Liquid Handling, Purification and Storage

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

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SECTION 01 11 10

COORDINATION OF WORK INCLUDING OWNER FURNISHED EQUIPMENT

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, including suppliers of Owner Furnished Equipment, the Contractor shall inspect and promptly report to the Owner 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 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, and shall obtain from each of the subcontractors and Owner Furnished Equipment suppliers a similar schedule and shall be responsible for all parties maintaining these schedules or for coordinating required modifications.

1.4 OWNER FURNISHED ITEMS

A. The following items will be furnished by the Owner to be installed, tested, integrated, and disinfected (as applicable) by the Contractor, as detailed on the Plans and Specifications or as otherwise necessary for a fully operable system. Owner furnished equipment will be stored at the District headquarters. The Contractor shall make arrangements for transport of the equipment to the project site.

1. Carbon Dioxide System including storage and solution feed skids. BlueInGreen: contact Simon Morris, JBI Water & Wastewater, (916) 642-5500.

2. Granular Activated Carbon (GAC) vessels. AqueoUSVets: contact Kelsey Hakes, (949) 531-0786.

3. Granular Activated Carbon (purchase of media and service/installation). Supplier TBD.

4. Switchboard, distribution board, and motor control centers, Contact Doug Cable, CED Royal Industrial Solutions, (805) 766-3894.

B. SUBMITTALS

1. The Owner has received initial submittals from AqueoUSVets for the GAC vessel systems and BlueinGreen for the carbon dioxide system, which have been included with the contract documents for reference. The Contractor shall be fully responsible for reviewing the equipment submittals and identifying all ancillary materials and installation steps required for fully operable systems and shall include the materials and installation labor in the bid price.

2. Detailed submittals for the other Owner Furnished Equipment are not included in the bid package but will be available within several weeks of project award. The Contractor shall contact equipment suppliers to ascertain requirements for installation and integration of the equipment and shall include the costs for such installation and integration in the bid price.

1.5 CONSUMABLES

A. The District will be furnishing the initial load of diesel fuel for the generator, sodium hydroxide, and carbon dioxide. The District will also provide any chemicals required for the existing chemical storage and feed systems. The Contractor shall be responsible for all other consumables necessary for testing and startup of the system.

1.6 SYSTEMS INTEGRATOR

A. A single firm, referred to as the Systems Integrator (SI), shall design and coordinate the proper functioning of all components incorporated into the existing facilities and improvements. The District utilizes a pre-selected SI as listed below. This includes all coordination with providers of chemical feed systems, instrumentation, standby diesel generator, electrical, controls, etc. However, the General Contractor shall remain responsible to the Owner for all equipment under the general guarantee. The contractor will be responsible, prior to the bid, in evaluating the contract specifications and requirements, and equipment necessary for a working facility into their bid. Special attention shall be directed to the PLC interface between the Owner Furnished Equipment and the District's PLC to ensure all power requirements, wiring and programming are coordinated between the systems prior to bidding. The contractor is required to coordinate all equipment and work scope prior to bid

B. Programming of the programmable logic controller shall be performed using the following pre-selected Systems Integrator:

1. RoviSys, POC: Adam Kelly, West Coast Business Development Manager, (330) 842-7732, adam.kelly@rovisys.com

END SECTION

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.

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 General Conditions.

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.

1.3 FINAL PAY QUANTITIES

A. Final pay quantities shall be in accordance with the General Conditions except as modified below.

B. Final pay quantities will be designated only in the Bid Schedule and in Section 01 22 00 – Explanation of Bid Items and are not shown on the Plans.

C. When an item of work is designated as a Final Pay Quantity on the Bid Schedule and/or in the Explanation of Bid Items, the estimated quantity for that item of work shall be the final pay quantity, unless the dimensions of any portion of that item are revised by the Engineer, or the item or any portion of the item is eliminated.

If the dimensions of any portion of the item are revised, and the revisions result in an increase or decrease in the estimated quantity of that item of work, the final pay quantity for the item will be revised in the amount represented by the changes in the dimensions.

If a final pay item is eliminated, the estimated quantity for the item will be eliminated.

If a portion of a final pay item is eliminated, the final pay quantity will be revised in proportion to the bid quantity represented by the eliminated portion of the item of work.

D. The estimated quantity for each item of work designated as a Final Pay Quantity on the Bid Schedule and/or in the Explanation of Bid Items shall be considered as approximate only, and no guarantee is made that the quantity which can be determined by computations, based on the details and dimensions shown on the plans, will equal the estimated quantity. No allowance will be made in the event that the quantity based on computations does not equal the estimated quantity.

E. In case of discrepancy between the quantity shown on the Bid Schedule for a final pay item and the quantity or summation of quantities for the same item shown on the plans, payment will be based on the quantity shown on the Bid Schedule.

1.4 PARTIAL PAYMENT

A. Attention is directed to the General Conditions which, except as modified herein, shall apply in its entirety.

1. The local agency shall withhold not less than 5 percent of the contract price until final completion and acceptance of the project.

2. Partial payments for materials on hand shall not exceed one hundred percent (100%) of the value of material delivered on site, properly stored in a secured fenced area subject to, or under the control of, the owner and local agency, and unused. Contractor shall submit copies of invoices of materials to support values. Materials stored shall be installed within 60 days of delivery for payment eligibility.

B. Payment shall not relieve the Contractor from its obligations under the Contact; nor shall such payment be construed as acceptance of any of the Work. Payment shall not be construed as transfer of ownership of any equipment or materials to the Owner. Responsibility of ownership shall remain with the Contractor who shall be obligated to protect any fully or partially completed work or structure for which payment has been made; or replace any materials or equipment to be provided under the Contract which may be damaged, lost, stolen or otherwise degraded in any way prior to acceptance of the Work.

1.5 FINAL PAYMENT

A. Notice of Completion will be filed in the normal course of business following the first regular meeting of the District Board which occurs far enough after Final Completion to allow for agendizing The District Board approval of the Notice.

B. Final payment will be due thirty-five (35) days after the recording of the Notice of Completion by the Owner.

C. Upon completion of the project the final contract prices shall be revised by change order, if necessary, to reflect the true quantities used at the stated unit price thereof

as contained in the Bidder's Proposal hereto attached. Payments on account thereof will be made as set forth in these Specifications.

1.6 SECURITIES IN LIEU OF RETENTION AND ESCROW AGREEMENT

A. At the request and expense of Contractor, securities equivalent to the amount withheld shall be deposited with Owner, or with a state or federally chartered bank in California as the escrow agent, who shall then pay those withheld moneys to Contractor. Upon satisfactory completion of the contract, the securities shall be returned to Contractor.

B. Alternatively, Contractor may request and the Owner shall make payment of retentions earned directly to the escrow agent at the expense of Contractor. At the expense of Contractor, Contractor may direct the investment of the payments into securities and Contractor shall receive the interest earned on the investments upon the same terms provided for in this section for securities deposited by Contractor. Upon satisfactory completion of the contract, Contractor shall receive from the escrow agent all securities, interest, and payments received by the escrow agent from Owner, pursuant to the terms of this section. Contractor shall pay to each subcontractor, not later than 20 days of receipt of the payment, the respective amount of interest earned, net of costs attributed to retention withheld from each subcontractor, on the amount of retention withheld to insure the performance of Contractor.

C. Securities eligible for investment under this section shall include those listed in Section 16430 of the Government Code, bank or savings and loan certificates of deposit, interest bearing demand deposit accounts, standby letters of credit, or any other security mutually agreed to by Contractor and Owner.

D. Contractor shall be the beneficial owner of any securities substituted for moneys withheld and shall receive any interest thereon.

ESCROW AGREEMENT FOR SECURITY DEPOSITS IN LIEU OF RETENTION

This Escrow Agreement is made and entered into by and between _____ _____ whose address is _____ _____ herein after called "Owner," _____ _____ whose address is _____ _____ hereinafter called "Contractor" and _____ _____ whose address is _____ _____ hereinafter called "Escrow Agent."

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

(1) Pursuant to Section 22300 of the Public Contract Code of the State of California, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by Owner pursuant to the Construction Contract entered into between the Owner and Contractor for _____ in the amount of _____ _____ dated _____ (hereinafter referred to as the "Contract"). Alternatively, on written request of the Contractor, the Owner shall make payments of the retention earnings directly to the escrow agent. When the Contractor deposits the securities as a substitute for Contract earnings, the Escrow Agent shall notify the Owner within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract between the Owner and Contractor. Securities shall be held in the name of _____, and shall designate the Contractor as the beneficial owner.

(2) The Owner shall make progress payments to the Contractor for those funds which otherwise would be withheld from progress payments pursuant to the Contract provisions, provided that the Escrow Agent holds securities in the form and amount specified above.

(3) When the Owner makes payment of retentions earned directly to the Escrow Agent, the Escrow Agent shall hold them for the benefit of the Contractor until the time that the escrow created under this contract is terminated. The Contractor may direct the investment of the payments into securities. All terms and conditions of this agreement and the rights and responsibilities of the parties shall be equally applicable and binding when the Owner pays the Escrow Agent directly.

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

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

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

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

(8) Upon receipt of written notification from the Owner certifying that the Contract is final and complete, and that the Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.

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

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

On behalf of Owner:	On behalf of Contractor:	On behalf of Escrow Agent:
Title	Title	Title
Name	Name	Name
Signature	Signature	Signature
Address	Address	Address

At the time the Escrow Account is opened, the Owner and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this Agreement.

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

Owner	Contractor
_____	_____
Title	Title
_____	_____
Name	Name
_____	_____
Signature	Signature

END SECTION

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 including furnishing a construction trailer and temporary fencing, 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. Payment shall not exceed 3 percent of the total project bid amount. 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 – **Demolition and Clearing:** This bid item is a lump sum bid for the cost of all work involved in demolition, removal of equipment and structures designated on the Plans for demolition, and clearing and grubbing the project site. 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 3 – **Worker Protection:** Payment for this item shall be considered full compensation for all labor, materials, tools, equipment and incidentals for providing for worker protection from caving ground in excavations and other hazards that may occur during construction. This bid item will be paid for by Lump Sum, prorated, based on percentage of contract work completed.

Bid Item 4 – **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 within the project limits. This bid item will be paid for by Lump Sum, prorated, based on percentage of contract work completed.

Bid Item 5 – **Dust Control:** Payment under this item shall be considered full compensation for all labor, materials, tools, equipment and incidentals required to perform dust control measures for the project limits in accordance with the Specifications. This bid item will be paid for by Lump Sum, prorated, based on percentage of contract work completed.

Bid Item 6 – **Prepare and Implement SWPPP:** Payment under this item shall be considered full compensation for all labor, materials, tools, equipment and incidentals required to provide and implement a Storm Water Pollution Prevention Plan (SWPPP) as specified, and for all necessary inspection, monitoring, testing and reporting services of the QSP if required under the State of California Construction General Permit and as set forth in the SWPPP. This bid item will be paid for by Lump Sum, prorated, based on percentage of work completed.

Bid Item 7 – **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 bid price. Payment will be prorated based on the percentage of contract work completed.

Bid Item 8 – **Installation and Testing of Owner Furnished GAC Systems:** This bid item includes installation, integration, testing, and disinfection of three (3) Owner-furnished 2-vessel GAC adsorption systems with included flow meters and valve trees and assisting with installation of separately-procured Owner-furnished activated carbon media. The Contractor shall be responsible for loading and transporting the GAC systems from the District headquarters. This bid item also includes furnishing all materials, labor and appurtenances required for construction of the GAC system foundation, off-skid manifold piping, motor operated control valves, fittings, pipe supports, manual valves, and appurtenances necessary for proper function of the GAC system as detailed in the Plans and Specifications. Completed item shall provide a complete and fully operational GAC system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 9 – **Installation and Testing of Owner Furnished Carbon Dioxide System:** This bid item includes installation, integration, and testing of one (1) Owner-furnished carbon dioxide storage and dissolution system. The Contractor shall be responsible for loading and transporting the system from the District headquarters.

The District will furnish the initial load of carbon dioxide. This bid item also includes furnishing all materials, labor and appurtenances required for construction of the carbon dioxide storage and dissolution system foundations, off-skid piping, fittings, pipe supports, valves, and other features necessary for proper function of the carbon dioxide system as detailed in the Plans and Specifications. Completed item shall provide a complete and fully operational carbon dioxide system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 10 – **Installation and Testing of Owner Furnished Electrical Panels:** This bid item includes installation, integration, and testing of one (1) Owner-furnished main switchboard, one (1) Owner-furnished integrated power center, and four (4) Owner-furnished motor control centers. The Contractor shall be responsible for loading and transporting the equipment from the District headquarters. This bid item also includes furnishing all materials, labor and appurtenances required for construction of the electrical equipment foundations and connection to conduits and conductors furnished under other bid items. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 11 – **Installation and Testing of Generator and Fuel Tank:** This bid item includes furnishing, installation, integration, and testing of one (1) 1 MW standby diesel engine generator and 12,000-gallon double wall fuel storage tank. This bid item also includes furnishing all materials, labor and appurtenances required for construction of the generator and fuel tank foundations, interconnecting fuel piping, connection to conduits and conductors furnished under other bid items, valves, fittings, pipe supports, and appurtenances for proper function of the generator and fuel system as detailed in the Plans and Specifications. The District will furnish the initial load of fuel. Completed item shall provide a complete and fully operational standby generator system. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 12 – **Asphalt Driveway:** This bid item is a lump sum bid for all work associated with constructing the asphalt concrete surfacing for the site access road. Work in this bid item shall include, but is not limited to, subgrade preparation, placing and compacting aggregate base and asphalt concrete pavement to the lines and grades shown on the Plans. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 13 – **Crushed Rock Surfacing:** This bid item is a lump sum bid for all work associated with constructing the crushed rock site surfacing. Work in this bid item shall include, but is not limited to, subgrade preparation, placing and compacting crushed rock 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 14 – **Grading/Earthwork:** This bid item includes rough and finish grading, import material and all labor and equipment required to complete the grading of the site including over excavation under all concrete slabs and compaction of fill material, fill areas, construction of the storm water basin with rip rap at outfalls, and spreading unsuitable material at the end of the job at the direction of the Owner. This bid item will be paid for by Lump Sum.

Bid Item 15 – **Furnish and Install 126,000 Gallon Bolted Backwash Tank:** This bid item includes furnishing and installing a 126,000-gallon bolted steel tank complete in place, and shall be full compensation for tank and foundation design; furnishing all labor, equipment and materials to complete the installation including foundation construction, anchorage, above-grade pipe tie-ins, asphalt walkway, tank construction, ladders, hatches, gauges, vents and other tank accessories, testing, and painting. This bid item will be paid for by Lump Sum.

Bid Item 16 – **Furnish and Install 85,000 Gallon Bolted Treated Water Tank:** This bid item includes: furnishing and installing a 85,000-gallon bolted steel tank complete in place, and shall be full compensation for tank and foundation design; furnishing all labor, equipment and materials to complete the installation, including foundation construction, anchorage, above-grade pipe tie-ins, asphalt walkway, tank construction, ladders, hatches, gauges, vents and other tank accessories, testing, painting, disinfection, and VOC testing. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 17 – **Furnish and Install Vertical Turbine Booster Pump Station:** This bid item includes furnishing, installing, and testing two (2) 100-HP barrel-mounted vertical turbine booster pumps, including associated foundations, manifold piping, valves, instruments, anchorage, and shall be full compensation for furnishing all labor, equipment and materials to complete the installation as indicated the Plans and Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 18 – **Furnish and Install Sodium Hydroxide Storage Tank and Enclosure:** This bid item includes furnishing, installing, and testing a double-wall sodium hydroxide polyethylene chemical storage tank, appurtenances, foundation, and chain link fence enclosure with roof as indicated in the Plans and Specifications. The District will furnish the initial load of sodium hydroxide. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 19 – **Furnish and Install Analyzer Enclosure:** This bid item includes furnishing all labor, equipment, and materials to complete the construction of an Analyzer Enclosure with foundation, floor drains, duplex Blue & White chemical metering pump skid, analyzer panel with water quality analyzers, shower/eyewash, hose bib, and all associated appurtenances as shown on the Plans and Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 20 – **Furnish and Install Yard Piping:** This bid item includes all below grade piping and appurtenances associated with the water, process, 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, backfill, and compaction, pipe, fittings, restrained joints, valves, manholes, cleanouts, catch basins, appurtenances, testing, 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 21 – **Furnish and Install Santa Rosa 8 Prelubrication and Chlorination:** This bid item includes furnishing all labor, equipment, and materials to provide a pump water lubrication system, drywell, and sodium hypochlorite feed line to Santa

Rosa Well 8 as defined in the Plans and Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 22 – **Furnish and Install Chain Link Fence and Gates:** This bid item includes all work associated with furnishing and installing a perimeter chain link fence including 8-foot chain link fence with barbed wire and privacy slats, three (3) 20-foot slide gates, one (1) 16-foot wide double swing gate, one (1) 30-foot wide double swing gate, and one (1) 30-foot automatic motor operated cantilever gate and all appurtenances required to enclose the site as specified in the Plans and Specifications. This bid item shall be paid for by Lump Sum on a prorated basis.

Bid Item 23 – **Painting and Coating:** This bid item includes painting and coating all tanks, pipe supports, and above ground piping, including associated preparation, application, testing and cleanup, and shall be full compensation for furnishing all labor, equipment, and materials to complete the painting and coating as indicated in the Plans and Specifications. This bid item also includes touch-up painting of pre-coated owner-furnished equipment. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 24 – **Electrical:** This bid item includes furnishing all electrical equipment not specifically identified as Owner-furnished as indicated in the Plans and Specifications; installing all electrical equipment, conduit, conductors, panels, transfer switch, and appurtenances, including Owner-furnished equipment; and construction of new electrical service. This bid item shall include all electrical panels, equipment, and interconnecting conduits and conductors to provide a fully operable facility. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 25 – **Instrumentation & Controls Integration:** This bid item includes instrumentation and controls integration, programming, and SCADA screen development by RoviSys including integration of all new subsystems and existing instrumentation and controls as necessary to result in a complete and fully operable facility. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 26 – **Startup & Testing:** This bid item includes furnishing services associated with startup and testing of the integrated facility including, but not limited to, the GAC systems, carbon dioxide system, sodium hydroxide system, backwash reclaim booster pumping station, new well pumps and ancillary instrumentation and controls. Refer to the specific requirements for each process in the Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

Bid Item 27 – **Operation & Maintenance Manuals and Record Drawings:** This bid item includes preparing and furnishing an operations and maintenance manual for all equipment and preparing and furnishing a complete set of record drawings. Refer to the specific requirements for each process in the Specifications. This bid item will be paid for by Lump Sum on a prorated basis.

END SECTION

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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. General Conditions

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.

PART 3 EXECUTION

NOT USED

END SECTION

SECTION 01 35 00

MATERIAL SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 GENERAL

A. The materials furnished and used shall be new, except as may be provided elsewhere in these Specifications, or on the Plans.

B. All materials required to complete the work under this contract shall be furnished by the Contractor, unless otherwise stated.

C. It shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instruction before proceeding with the Work. The Engineer may, by appropriate instructions, correct said apparent errors and omissions, which instructions shall be as binding upon the Contractor as though contained in the original Contract Documents.

1.2 DEFINITIONS

A. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor.

B. Revisions: Changes to Contract Documents requested by Owner or Engineer.

C. Options: Specified options of products and construction methods included in Contract Documents.

1.3 TRADE NAMES AND ALTERNATIVES

A. Wherever an article, or any class of materials, is specified by the trade name and model number and does not include the term “or equal”, it shall be taken as intending to mean that specific trade name and model number. No product substitutions will be accepted.

B. Wherever an article, or any class of materials, is specified by the trade name or by the name of any particular patentee, manufacturer or dealer, or by reference to the catalog of any such manufacturer or dealer, with the description “or equal” it shall be taken as intending to mean and specify the article or material described or any other equal thereto in quality, finish and durability, and equally as serviceable for the purpose for which it is or they are intended. The intent of the Plans and Specifications is to specify highest grade standard equipment, and it is not the intent of these Plans and Specifications to exclude or omit the products of any responsible manufacturer, if such products are equal in every practical respect to those mentioned herein, as determined by the Engineer.

1.4 SAMPLES

A. At the option of the Engineer, the source of supply of materials for the Work shall be subject to tests and inspection before the delivery is started and before such materials are used in the Work. Samples representative of the character and quality of materials shall be submitted by the Contractor. Samples shall be of sufficient quantities or amounts for testing or examination.

B. All tests of materials furnished by the Contractor shall be made in accordance with the commonly recognized standards of national technical organizations, and such special methods and tests as are prescribed in the Contract Documents.

C. The Contractor shall furnish such samples of materials as are requested by the Engineer, without charge. No material shall be used until the Engineer has had the opportunity to test or examine such materials. Samples will be secured and tested whenever necessary to determine the quality of the material. Samples and test specimens prepared at the jobsite, such as concrete test cylinders, shall be taken or prepared by the Engineer, or his designated representative, in the presence and with the assistance of the Contractor.

1.5 SUBMITTALS

A. Material Submittals shall be made in accordance with Section 01 33 00 – Submittals.

1.6 INSPECTION OF MATERIALS BY THE CONTRACTOR

A. Contractor shall make a close inspection of all materials as delivered, and shall promptly return all defective materials without waiting for their rejection by the Engineer.

1.7 CERTIFICATES OF COMPLIANCE

A. A Certificate of Compliance may be required for certain materials and equipment that become final products of the completed Work. Certificates of Compliance shall be furnished prior to the use of any materials for which these Specifications require that such a certificate be furnished. In addition, when so authorized in these Specifications, the Engineer may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance.

B. The Certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications.

C. A Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.

D. All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Plans and

Specifications and any such material not conforming to such requirements will be subject to rejection whether in place or not.

E. The Owner reserves the right to refuse to permit the use of material on the basis of a Certificate of Compliance.

1. The form of the Certificate of Compliance and its disposition shall be as directed by the Engineer.

1.8 MANUFACTURER TESTING

A. At the option of the Engineer, materials and equipment to be supplied under this Contract will be tested and inspected either at their place of origin or at the site of the Work. The Contractor shall give the Engineer written notification well in advance of actual readiness of materials and equipment to be tested and inspected at point of origin.

1. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or re-inspection at the site of the Work.

2. Materials and equipment which will require testing and inspection at the place of origin shall not be shipped prior to such testing and inspection.

1.9 MANUFACTURERS' RECOMMENDATIONS

A. All equipment specified and used in the project shall be installed in accordance with the approved manufacturer's current written recommendations.

B. All such equipment, material, etc., shall be of the manufacturer's latest system or line.

1.10 SUBSTITUTIONS

A. Conditions: Contractor's substitutions shall be considered when one or more conditions are satisfied, as determined by the Engineer. (The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.)

1. Extensive revisions to Contract Documents are not required.

2. Proposed changes are in keeping with the general intent of the Contract Documents.

3. Request is timely, fully documented and properly submitted.

4. Request is directly related to an "or equal" clause or similar language in the Contract Documents.

5. The specified product or method of construction cannot be provided within the Contract Time. The request shall not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

6. The specified product or method of construction cannot receive necessary approval by governing authority, and the requested substitution can.

7. Substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear.

    a. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

    b. Contractor shall provide all data in support of any proposed substitute or “or-equal” at Contractor’s expense.

8. Specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.

9. Specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.

10. Specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

END SECTION

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: _____

We hereby submit for your consideration the following product instead of the specified item for the above project:

SECTION: _____ PARAGRAPH: _____ SPECIFIED ITEM: _____

Proposed Substitution: _____

Attach: 1) Complete technical data, including laboratory tests, if applicable.

2) Complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

A. Does the substitution affect dimensions on Drawings?

B. Will the undersigned pay for changes to the project design, including engineering and detailing costs caused by the requested substitution?

C. What affect does substitution have on other trades?

D. Differences between proposed substitution and specified item?

E. Manufacturer's guarantees of the proposed and specified items are:

____Same _____ Different (explain on attached sheet)

SUBSTITUTION REQUEST FORM

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted By:

Signature _____

Firm _____

Address _____

Date _____

Telephone _____

For Use by Design Consultant
Accepted Accepted as Noted Not Accepted Received Late By_____ Date_____ Remarks_____

SECTION 01 43 00

QUALITY CONTROL AND TESTING

PART 1 GENERAL

1.1 NOTICE OF DEFECTS

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

B. All defective Work may be rejected, ordered to be corrected, or accepted, at the discretion of the Owner and Engineer.

1.2 ACCESS TO WORK

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests shall have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith.

1.3 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be subject to the requirements of Section 01 35 00 – Material Substitution Procedures.

1.4 PROJECT SITE TESTING

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Except for specified material suitability tests, all initial routine tests of materials shall be at the expense of the Owner and shall be performed by an independent certified laboratory designated by the Owner. Whenever a specified percent relative compaction test is required and the material or portion thereof so tested fails to meet or exceed the relative compaction specified, all subsequent retesting shall be performed at the expense of the Contractor.

1.5 TEST STANDARDS

A. All sampling, specimen preparation, and testing of materials shall be in accordance with the standards of nationally recognized technical organizations.

B. The physical characteristics of all materials not particularly specified shall conform to the latest standards published by the ASTM, where applicable.

1.6 UNCOVERING WORK

A. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without concurrence of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and recovered at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be re-observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall promptly correct said defects, including all work involved in uncovering and recovering the work, at no cost to the Owner.

2. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction.

1.7 CORRECTION OR REMOVAL OF DEFECTIVE OR REJECTED WORK

A. Upon receipt of notice, Contractor shall correct all defective or rejected Work and replace it with Work that is not defective, at no cost to the Owner.

1.8 ACCEPTANCE OF DEFECTIVE WORK

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so.

1. If any such acceptance occurs, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted.

2. Engineer shall determine the reasonableness of the diminished value of Work so accepted and Contractor shall pay all costs involved in making such determination.

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. See Section 01 51 36 -- Watering of these specifications for details.

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 and the State. State and County 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 OFFICE TRAILER

A. For the entire duration of construction, the Contractor shall furnish a trailer with power for use as a field office for Construction Manager and Owner staff. The trailer shall have a conference table, desk, chairs and have adequate room to accommodate 10 people during meetings.

B. The modular office trailer shall have lockable entrances, operable windows, and serviceable finishes; be heated and air conditioned; include a code-certified prefabricated entrance; include skirting; and be supported on foundations adequate for normal loading and provided with tie-downs.

C. Prepare and submit for approval shop drawings prepared and signed by a Professional Engineer registered in California. Submit shop drawings for the electric service prepared and signed by a Professional Engineer or Master Electrician licensed in California.

1.5 ACCESS ROADS AND STAGING AREA

A. Adequate 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

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SECTION 01 51 36

WATERING

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work of this section consists of furnishing, hauling, and applying water required for compaction of embankments, backfills, subgrade, and base course, and for landscaping, and other construction operation.

1.2 RELATED WORK

A. Section 01 50 00 – Temporary Facilities

B. Section 01 57 27 – Dust Control

1.3 REFERENCES

A. State Standard Specifications Section 10-6, Watering

PART 2 PRODUCTS

2.1 WATER

A. Free of debris, organic matter, and other objectionable substances.

PART 3 EXECUTION

3.1 WATER TRUCK

A. At least 1,000-gallon capacity.

B. Keep at least one water truck on site at all times, unless Engineer approves removal of the truck from the site before final completion.

3.2 APPLICATION

A. Use pressure type distributors or a pipeline equipped with sprinkler system. Provide approved meter devices near points of discharge.

B. Ensure a uniform application of water for optimum moisture content. Avoid excessive runoff and minimize water waste.

C. The Contractor may water excavation areas before excavating. Drill full depth of excavation to make moisture determinations.

D. If over watering occurs, de-water at no additional expense to the Owner.

3.3 SPECIAL CONTROLS

The Contractor shall take all reasonable means to minimize inconvenience and injury to the public by dust, noise, diversion of storm water, or other agencies under his control.

A. Dust Control

1. As specified in Section 01 57 27, Dust Control

B. Water

1. The Contractor shall pay for and shall construct all facilities necessary to furnish water for his use during construction. The District will not charge for use of water but the Contractor will be required to obtain a fire hydrant meter for tracking purposes and leave a deposit with the District.

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.

3. Full compensation for furnishing all labor, materials, tools and equipment and for doing all work involved in furnishing and applying water as required by the Contract Documents and Specifications, State Standard Specifications, shall be considered as included in the contract unit prices paid for other items of work and no additional allowance will be made therefore.

END SECTION

SECTION 01 57 19

ENVIRONMENTAL PROTECTION MEASURES

PART 1 GENERAL

1.1 GENERAL

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

1.2 NOISE

A. Noise generating equipment used during construction shall be restricted to the hours from 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 6:00 p.m. on Saturday and Sunday. Construction outside of these hours shall require written approval by the Owner. Effective mufflers shall be fitted to gas-powered and diesel-powered equipment.

1.3 BIOLOGICAL RESOURCES

A. Mitigation Monitoring and Reporting Requirements:

1. It is the intent that all construction activities shall be performed from September 16 through January 31 in an effort to avoid impacts to nesting birds. If at any point in time the Contractor believes construction will be required outside this timeframe the Owner and Engineer shall be informed immediately to discuss further action.

2. If any work is required within February 1 through September 15, the Owner will hire a qualified biologist to conduct preconstruction surveys no less than 10 days prior to the start of construction activities.

3. If active nests are discovered, an appropriate buffer/exclusion zone will be provided and identified by flagging, fencing or other visible means by the qualified biologist until the biologist has determined that the nestlings have fledged and are no longer dependent on the nest.

4. If the preconstruction survey identified coastal California Gnatcatcher or Least Bell's Vireo species, additional measures will be required and determined by a qualified biologist prior to the start of construction.

5. All personnel associated with Project construction are required to attend an environmental tailboard (Worker Environmental Awareness Program (WEAP)) training conducted by a qualified biologist prior to the start of construction. The training will detail the measures to be implemented to protect sensitive resources in the project area. The Owner will hire a qualified biologist to conduct said training.

B. Operational Hours

1. Construction activities shall be limited to daylight hours to reduce potential impacts to special status bat species.

C. Site Maintenance Requirements:

1. Construction equipment shall arrive at the site clean to prevent the potential spread of noxious weeds.

2. Waste and recycling receptacles that discourage foraging by wildlife species adapted to urban environments shall be installed and maintained, by the Contractor, in common areas throughout the project site for the duration of construction.

1.4 CULTURAL RESOURCES

A. Discovery of Archaeological and Human Remains:

1. In the event that archaeological remains 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 District 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 Ventura County Coroner is to be notified to arrange their 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.

1.5 Wildfire Precautions

A. Defensible Spaces

1. Provide defensible space by maintaining highly flammable vegetation, as appropriate, near Project activities that may create sparks to reduce fire fuel.

2. Dispose of debris, such as dry debris, leaves, and dead limbs near and within the Project site.

3. Design defensible spaces with fire breaks around the Project site, as appropriate.

B. Fire Suppression

1. Provide adequate water sources on-site during high fire risk construction activities to include, but not limited to, a water truck, water backpacks, and/or fire extinguishers.

END SECTION

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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 Camrosa Water District.

2. The Approved Signatory for the LRP is Mr. Ian Prichard.

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 District 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 District 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, and in accordance with the Dust Control Plan (DCP). The DCP can be amended, by the Owner and/or Contractor, as needed should revisions be determined necessary during construction activities.

1.2 RELATED WORK

A. Section 01 50 00 – Temporary Facilities

B. Section 01 51 36 – Watering

C. Division 2 – Existing Conditions

D. Division 31 – Earthwork

1.3 REFERENCES

A. Ventura County Air Pollution Control District (VCAPCD).

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. The revised DCP shall show proposed arrangements and methods for dust control. Show that the plans satisfy all VCAPCD, State, and Federal Requirements.

2. Provide proof that the revised DCP has been submitted to the VCAPD 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 VCAPCD 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. Water shall be available to the contractor for dust control as specified in section 01 50 00 – Temporary Facilities.

B. 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 VCAPCD.

C. Gravel used for Gravel Pads shall be washed gravel, a minimum of one inch in diameter, and shall be placed a minimum of three 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 VCAPCD of dust control methods utilized during the course of construction. The Contractor shall utilize the forms provided by the VCAPCD, available on the VCAPCD 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 VCAPCD 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 01 57 50

CONSTRUCTION STAKES, LINES, AND GRADES

PART 1 GENERAL

1.1 LINES AND GRADE

A. The Work shall be executed in accordance with the lines and grades indicated in the Contract Documents. Distances and measurements, except elevations and structural dimensions, shall be made on horizontal planes.

1.2 RESPONSIBILITY FOR SURVEY SERVICES

A. Construction surveying and staking for construction will be performed by the Contractor at the Contractor's expense.

B. Additional detail staking layout will also be the responsibility of the Contractor.

C. The Contractor shall be responsible for preserving construction survey stakes, permanent survey monuments and bench marks for the duration of their usefulness. If any construction survey stakes permanent survey monuments or benchmarks are lost or disturbed and need to be replaced, such replacement shall be made by the Contractor at the expense of the Contractor.

END SECTION

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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 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, electrical panels, treated water storage tank and appurtenances, miscellaneous debris, signs, barriers, salvaged items, and portions of abandoned utilities.

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 trees and landscaping as required for construction.

1.3 RELATED WORK

A. Section 01 57 23 – Storm Water Pollution Prevention Plan

B. Section 01 57 27 – Dust Control

C. Section 03 30 01 – Cast In Place Concrete

D. Section 31 11 00 – Clearing and Grubbing

E. Section 31 23 00 – Earthwork.

1.4 SEQUENCING

A. Sequence work to minimize interference with water facilities operation. The water facilities, with the exception of the Calleguas blending station may generally be taken out of service for construction. Coordinate the timing of all equipment outages with the Owner.

1.5 REGULATORY REQUIREMENTS

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

1.6 REFERENCES

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

B. Section 19 – Earthwork, State Standard Specifications

1.7 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.

1.8 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.

1.9 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. Notify the Owner when uncovering or tying in to existing utilities and provide Owner with the opportunity to observe the work.

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.

1.10 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 30 01 – Cast In Place Concrete.

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

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

2.2 MATERIALS

A. Salvaged Materials: Materials to be salvaged shall remain the property of the Owner and shall be delivered to the District's main office. Contractor shall inventory all salvaged materials. Stockpiled materials shall be free of hazardous substances. Salvage materials include:

1. Certain components from the MCCs

2. Motors

3. Instruments

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. 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.

3.5 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.

3.6 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.

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 01 – Cast-in-Place Concrete

B. Section 03 60 00 - Grout

C. Section 05 50 00 – Fabricated Metal

D. Section 06 10 00 – Rough Carpentry

1.3 SUBMITTALS

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

1.4 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.

B. 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.

C. 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 ICC Evaluation Service 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 F1554, Grade 55 with ASTM A563 nuts
2. Stainless Steel	ASTM 593 with ASTM F594 nuts
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 Kwik Bolt TZ ICC ESR-1917, Simpson Strong-Bolt 2 ICC ESR 3037, or ICC approved equivalent.
E. Adhesive Anchors	Hilti HIT RE-500 V3 ICC ESR 3814, ITW Red Head A7+ICC ESR 3903 or ICC approved equivalent.

1. Anchor bolts, threaded rod anchors, expansion bolts and adhesive anchors for buried service, splash zones, and immersion service shall be stainless steel. Anchor bolts, threaded rods and adhesive anchors for exterior use shall be hot dipped galvanized. Zinc coated expansion anchors shall not be used for buried, splash zone, immersion or exterior service.

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 ICC Evaluation Service 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.

3.3 ADHESIVE ANCHORS

A. Adhesive anchors shall be installed in conformity with the manufacturer's instructions and ICC Evaluation Service Report recommendations. Anchors must be installed in holes drilled using carbide-tipped drill bits or diamond core drill bits. Should diamond core drill bits be used, the manufacturer’s roughening tool must be used in conjunction with the bit.

END SECTION

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SECTION 03 30 01

CAST-IN-PLACE 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 form work including special forms as required for any special construction and/or to accommodate the work of others and removal of forms.

2. All concrete reinforcement, placement, bending and forming thereof.

3. All concrete and cement finishing, all surface treatment and curing including non-slip finishes.

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

5. 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.

6. Setting headers and screens finishing, curing, 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. Division 3 – Concrete

B. Division 10 – Specialties

C. Division 31 – Earthwork

D. Division 32 – Exterior Improvements

E. Division 33 – Utilities

F. Section 05 50 00 – Metal Fabrications

G. Section 05 05 20 – Bolts, Washers, Anchors and Eyebolts

H. Section 09 90 00 – Painting and Coating

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. Submittals shall be in accordance with Section 01 33 00 of these Specifications.

B. Provide material certificates, mix designs including laboratory testing, shop fabrication and placement drawings, and schedule for all reinforcing steel, embedded 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 50 feet apart (unless specifically approved otherwise by the Engineer), and a pour schedule for the individual slab and wall pours.

PART 2 PRODUCTS

2.1 CONCRETE

A. Concrete shall conform to Section 90 of the State Standard Specifications. Portland cement shall be Type II/V. Unless otherwise shown on the concrete note sheet or specified in other sections, all concrete shall conform to the following:

Location	28-day Compressive Strength	Minimum Cement Content	Maximum W/C	Slump
Structural concrete, slabs and footings	4,000	570	0.50	4 inches +/- 1 inch
Pavement, sidewalks, and drive approaches	3,000	517	0.55	4 inches +/- 1 inch

B. Concrete used for thrust blocks or for pipe encasement 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. 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 19-3.02E of the State Standard Specifications.

D. Fly ash cannot be substituted for Portland Cement.

2.2 AGGREGATE

A. Aggregate for normal weight concrete shall conform to Section 90-1.02C, “Aggregates” of the State Standard Specifications. 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), “Aggregate Gradation” of the State Standard Specifications, Combined Aggregate Gradings.

2.3 WATER

A. Water shall comply with Section 90-1.02D, “Water” of the State Standard Specifications, and 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: Shall comply with SSS Section 90-1.02B(3), “Supplementary Cementitious Materials”, and shall comply with AASHTO M 295, Class F or N.

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

B. The combined weight of fly ash conforming to AASHTO M 295, Class F or N shall not exceed the amount provided for in Section 90-1.02B(3), “Supplementary Cementitious Materials” of the State Standard Specifications.

2.5 ADMIXTURES

A. Admixtures shall comply with Section 90-1.02E, “Admixtures”, of the State Standard Specifications

B. Air Entraining: ASTM C260

C. Water Reducing: ASTM C494, Type A, D or F

D. Accelerating: ASTM C494, Type C or E

1. No admixture containing any chloride ions is acceptable.

E. Retarding: ASTM C494, Type B, D or G

2.6 REINFORCING STEEL

A. Rebar shall be ASTM A615, Grade 60.

B. Welded wire fabric shall conform to ASTM A1064.

2.7 EXPOSED-TO-VIEW CONCRETE

A. For exposed-to-view concrete, where legs of metal supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I).

B. Metal bar supports in slab covers for sewage-containing structures shall also be provided with plastic coated legs.

2.8 FORM MATERIALS

A. Exposed Concrete: Plywood complying with U.S. Plywood Standard PS-1 “BB (Concrete Form) Plywood” Class I, or better.

B. Textured Finish Concrete: Units of face design, size arrangement and configuration to match control sample.

C. Cylindrical Columns and Supports: Metal, fiberglass or waxed paper tubes of sufficient wall thickness to resist imposed loads without deformation.

D. Form Release Agent shall leave behind a paintable concrete surface.

1. Release #1, The Burke Co., or Engineer approved equivalent.

2.9 CURING MATERIALS

A. Polyethylene film

B. Reinforced waterproof paper

1. Sisal Kraft, Orange Label, or approved equal.

C. Liquid-membrane curing compound

1. Curing compound shall comply with ASTM C309, Type 2.

a. White pigmented material

b. Clear pigment may be used for concrete that will be exposed to public view.

PART 3 EXECUTION

3.1 REINFORCING STEEL

A. Comply with CRSI, “Placing Reinforcing Bars” and as specified herein.

B. Place reinforcing steel and embedded items in accordance with approved shop drawings.

C. Splicing of bars shall be by lapping. Lapped splices shall be 50 bar diameters for bar size through #6 and 62 bar diameters for larger bars, unless otherwise shown on the Plans.

D. Splicing of the wire fabric shall be by lapping. Lapped splices shall be two full mesh, minimum.

E. All rebar in vertical walls shall be supported by concrete block spacers or metal chairs.

F. Prior to placement of the concrete, reinforcing steel shall be cleaned and free of all concrete, dirt, oil, mill scale, rust or other coatings that would reduce or destroy the bond.

G. All reinforcing steel and embedded items shall be reviewed and approved by the Engineer prior to concrete placement.

3.2 FORMS

A. All forms shall be cleaned and an approved agent applied each time they are used and shall be so constructed and set as to resist, without springing or settlement, the pressure of the concrete and the placing operations.

B. In designing forms and falsework, the concrete shall be treated as a liquid weighing at least 150 lbs. per cubic foot for vertical loads and not less than 85 lbs. per cubic foot for horizontal pressure. The design of the forms and falsework system shall include allowances for temporary construction loads. The rate of placement of concrete shall be so regulated that the pressures caused by the wet concrete will not exceed the designed form pressure. The unsupported length of wooden columns and compression members shall not exceed 30 times the width of the least side.

C. All forms shall be set and maintained in true alignment, grade and section until the concrete has sufficiently set. The interior surfaces of forms shall be adequately treated with an acceptable material to insure non-adhesion of mortar. All forms shall be mortar-tight. When forms appear to be unsatisfactory in any way, concrete placement shall be stopped until the defects have been corrected.

D. All exposed outside corners, including the top edges of all walls, machinery bases and curbs shall have a ¾-inch chamfer.

E. Metal tie rods or anchorages within the forms shall be fitted with suitable cones or comparable devices. Metal tie rods or anchorages shall be removed to a depth of 1" from the surface without injury to the concrete. All fittings for metal ties shall be of such design that upon their removal, the cavities which are left will be of the smallest possible size, but of sufficient diameter to allow the cavity to be "dry packed" with cement mortar. The cavities shall be filled with cement mortar and the surface left sound, smooth and even.

F. Form release agent shall be applied to the form so that no agent comes in contact with reinforcing steel.

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 48 hours (2 working days) 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 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

E. Construction Joints

1. Ensure the end forms of walls are removable without releasing the side forms. Provide seals around reinforcement 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 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 20 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. 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.

4. 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.

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

6. Cover horizontal wall joints and wall-to-slab joints with a minimum thickness of 2 inches and a maximum of 6 inches of the modified concrete mix, consisting of the designated concrete mix with one-half of the coarse aggregate removed.

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

D. Expansion Joints

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

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

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

4. 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.

3.5 CONCRETE 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 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.

1. Curing shall continue for a period of not less than 7 days after placing the concrete. If curing compound is used, two (2) applications will be made for even coverage. Curing methods must be approved by the Engineer.

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 MCC 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. Deviation in finish surface shall not exceed ¼" in 10 ft.

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. General: Test all concrete tanks, hydraulic channels, sumps, basins, inlets, manholes and other structures designed to contain water, after concrete has reached the design strength, prior to backfilling, and application of any coating system. Test shall be performed by filling the structure with water.

B. Preparation: Provide the following.

1. All water necessary for testing shall be of acceptable quality.

2. All evaporation and level measuring devices required.

3. All pumps, power, piping and any other equipment required. Make all hook-ups necessary to fill tanks for testing.

4. The water disposal method after testing is complete, including pumping if necessary.

5. Fill the structure with water to the extreme high operating surface level or to overflow weir level. Furnish and install temporary bulkheads, if required.

6. Maintain full for 48 hours before beginning the test period to permit concrete absorption and adjustment of valves, slide gates, or temporary bulkheads.

7. At completion of tests remove all temporary piping and connections. Dispose of wastewater without creating a nuisance of damage to adjacent property.

C. Test Period: Five consecutive 24-hour periods totaling 5 consecutive days. Take daily measurements of air and water temperature, rainfall and water level.

D. Test Procedure

1. After test period, measure water level at each side of the tank to determine leakage and loss from evaporation.

2. Determine evaporation loss, using a standard 48-inch evaporation pan and level measuring device located adjacent to the tank.

3. Mark all observed damp areas, running or dripping leaks on exposed surfaces that have not healed autogenously during the test. Damp areas includes areas if moisture can be transferred from the exterior surface to a dry hand. Repair all those areas.

4. If leakage from the structure exceeds that permitted for the types of mechanical equipment providing closure plus 0.075% of the storage capacity, in each 24-hour period over a period of five consecutive days, perform a retest after completing repairs.

5. Provide acceptable procedures prior to repairs. Repairs by painting or surface treatment will not be acceptable.

6. Continue the test and repair procedure until the structure satisfies both the leakage calculation requirement and the visible leakage requirement.

E. Test for Manholes

1. Furnish and dispose of water used for testing.

2. Hydraulically test all manholes installed.

3. After all pipe has been laid, backfilling has been completed, and after the testing of the pipes, plug the end of the pipe stubs in each manhole with flexible-joint caps, or acceptable alternate, securely fastened.

4. Fill the manhole with water and measure leakage over a period of not less than one hour.

5. Allowable Leakage: less than one (1) gallon per hour per 10-foot depth of manhole.

6. When leakage from the manhole exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.

7. Repair all visible leaks even if manhole passes the leakage test.

END SECTION

SECTION 03 60 00

GROUT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Epoxy grouting of anchor bolts and reinforcing bars to be installed in hardened concrete.

B. Adhesive bonding of fresh concrete to existing hardened concrete surfaces.

C. Installation of pipe and sleeve into existing concrete.

D. Structure and Equipment leveling pads.

1.2 RELATED WORK

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

B. Section 03 30 01 - Cast-in-Place Concrete

1.3 SUBMITTALS

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

PART 2 PRODUCTS

Material Type	Approved Product
1. Non-shrinking Grout	L&M Chemical "Crystex", Gifford-Hill "Supreme", Master Builders "Masterflow 713 Grout" Sauereisen Cements "F-100 Level Fill Grout", U.S. Grout "Five Star Grout", UPCO "Upcon High Flow" or "Upcon Super Flow", or equal.
2. Epoxy Grout	
a. Adhesive, Moisture insensitive	
For floors and horizontal surfaces	Adhesive Engineering "Concresive 1539", Rescon "Concrete Bonder R616", or equal
For vertical walls or overhead applications, non-sagging consistency	Adhesive engineering "Concressive 1440" Rescon "Concrete Bonder R616" or equal
b. Aggregate	As recommended by the epoxy grout manufacturer
3. Epoxy Bonding Adhesive	Sikadur 32, Hi-Mod Master Builders Concresive Standard Liquid or equal.
4. Water	Clean and free from deleterious substances.

A. Non-shrinking grout shall be furnished factory premixed, so only water is added at jobsite. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

1. Cured grout shall have a minimum compressive strength of 3500 psi.

B. Epoxy grout shall consist of a two component liquid epoxy adhesive of appropriate viscosity for the application and location and an inert aggregate filler component. Components shall be packaged separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

1. Cured grout shall have a minimum compressive strength of 3500 psi.

PART 3 EXECUTION

3.1 PREPARATION

A. The concrete surface to receive non-shrinking grout shall be saturated with water for 24 hours prior to grouting.

B. Where indicated on the drawings, dowels shall be epoxy grouted in holes drilled into hardened concrete. Hole diameter shall be as recommended by the manufacturer. The embedment depth for epoxy grouted dowels shall be as indicated on the Plans.

C. Holes shall be prepared for grouting as recommended by the grout manufacturer.

D. The existing concrete surface to receive fresh concrete shall be clean and sound. The existing surface may be dry or damp, but free of standing water, free of dust, laitance, grease, airing compounds, and disintegrated materials. The existing concrete surface and rebar shall be sand blasted or cleaned by approved mechanical methods.

3.2 INSTALLATION

A. Non-shrinking Grout

1. Placement - Unless otherwise specified or indicated on the Plans, the thickness of grout shall be 1-1/2 inches. Grout shall be placed in strict accordance with the directions of the manufacturer.

2. Edge Finishing - The grout shall be finished smooth in all locations where the edge of the grout will be exposed to view after it has reached its initial set. Except where indicated to be finished on a slope, the edges of grout shall be cut off flush at the base plate, bedplate, member, or piece of equipment.

3. Curing – Non-shrinking grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. After edge finishing is complete, the grout shall be wet cured for at least 7 days.

4. Epoxy Grout - Dowels shall be clean, dry, and free of grease and other foreign matter at time of installation. The bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken

to ensure that all spaces and cavities are filled with epoxy grout, without voids.

B. Epoxy Bonding Adhesive: Pre-mix each component as specified by manufacturer. Mix only that quantity that can be applied within its pot life. Apply as specified by manufacturer.

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 RELATED WORK

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

1.3 DESIGN CRITERIA

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

1.4 REFERENCES

A. American Institute of Steel Construction (AISC)

B. American Society for Testing and Materials (ASTM)

C. Research Council on Structural Connections (RCSC)

1.5 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 ANCHOR BOLTS

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

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 DRILLED ANCHORS

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

2.7 EPOXY ANCHORS

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

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 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 360-16, 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.

END SECTION

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SECTION 05 50 00

FABRICATED METAL

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide metals work for pipe supports, hose rack, panel supports and other miscellaneous metal works, complete as indicated, specified and required.

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

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

3. Guard post assemblies for removable and stationary types

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

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

6. 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 01 – Cast-In-Place Concrete

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 and HSS shapes)	A36	--
Rolled W shapes	A992	Grade 50
HSS Shapes	A500	Grade B
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 HIT RE-500 V3 ICC ESR 3814 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 TZ ICC ESR-1917, 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 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work required under this section consists of all carpentry, general work and related items necessary and required to complete the work indicated on the drawings and/or described in the specifications. The Contractor shall provide all items, articles, materials, operations, or methods listed, mentioned or scheduled on the drawings and/or specified herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

B. Types of work in this section include rough carpentry for:

1. Wood framing, blocking, furring, bucks, backing and nailing blocks.
2. Timbers for posts and beams.
3. Drafts stops, fire stops installed per the latest edition of the C.B.C.
4. Rooftop equipment bases and support curbs.
5. Backing behind interior wall finishes.
6. Building paper.
7. Structural plywood.
8. Joist hangers and framing connectors, miscellaneous iron and rough hardware.
9. Underlayment.
10. Installation of any work not specified to be installed by the supplier.

1.2 RELATED WORK

A. Section 03 30 01 – Cast in Place Concrete

B. Section 05 50 00 – Fabricated Metal

1.3 DEFINITIONS

A. Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated.

1.4 SUBMITTALS

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

B. Product Data: Submit manufacturer's specifications and installation instructions for materials listed below:

1. Structural sheathing, roof and wall.

2. Underlayment.

C. Material Certificates: Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of American Lumber Standards Committee.

D. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation and finishing of treated material.

E. Preservative Treatment: For each type specified, include certification by treating plant, stating type of preservative solution and pressure process used, net amount of preservative retained and conformance with applicable standards.

F. For water-borne treatment include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.

1.5 PRODUCT HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

B. For lumber and plywood pressure treated with waterborne chemicals, sticker between each course to provide air circulation.

1.6 PROJECT CONDITIONS

A. Coordination: Fit carpentry work to other work; scribe and scope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 **PRODUCTS**

2.1 LUMBER, GENERAL

A. Lumber Standards: Reference standard for this specification is West Coast Lumber Inspection Bureau "Standard Grading Rules for West Coast Lumber, No. 16 latest Edition and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Inspection Agencies: Inspection agencies and the abbreviations used to reference with lumber grades and species under provisions of these codes currently accepted by the International Conference of Building Officials include the following:

RIS – Redwood Inspection Service.
NLGA – National Lumber Grades Authority (Canadian).
PLIB – Pacific Lumber Inspection Bureau.
WCLIB – West Coast Lumber Inspection Bureau.
WWPA – Western Wood Products Association.

C. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber apply grade stamps to ends or back of each piece or omit grade stamps entirely and issue certificate of grade compliance from inspection agency in lieu of grade stamp.

D. Sizes: Unless otherwise indicated, all lumber shall be surfaced four sides (S4S) and shall conform to those sized indicated by Rule 16 which establishes standard sizes for "unseasoned" (S-GRN) and "dry" lumber (S-Dry).

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Lumber shall be dried to 19% maximum moisture content when delivered to site. "Dry" - where indicated as "dry," all lumber 2" and thinner shall be or kiln-dried to a maximum moisture content of 19% prior to surfacing and shall bear the term "dry" within the grade stamp.

3. Species: dimension lumber shall be Douglas Fir unless otherwise indicated in the plans or specifications.

2.2 GRADE REQUIREMENTS FOR SPECIFIC USES:

A. The below-noted requirements are to be held as minimum standards and, unless otherwise noted on the drawings, the following grades shall be used:

1. Studs, blocking and top plates - No. 1 (paragraph 123-b, 124-b).

2. 4" x 4" plates, where indicated - select struct. D.F., (para. 124-a).

3. Posts 4" x 4" or less - select struct. D.F., (para. 124-a).

4. Posts 4" thickness and less, 6" and wider – No. 1 (para. 123-b).

5. One-piece posts greater than 4" nom. width – No. 1 (para. 131-b).

6. Joists, rafters, purlins, "built-up" beams – No. 1 (para. 124-a).

7. Exposed beams 4" thickness or less – select struct. D.F., (para. 124-a).

8. Unexposed beams 4" thickness or less – No. 1, (para. 123-b).

9. Plywood sheathing (roofs, walls, floors) – Douglas Fir – Structural 1 per PS 1-83.

10. Sills shall be Foundation Grade Redwood, produced and graded in accordance with "Standard Specifications for Grades of California Redwood Lumber of the California Redwood Association." Alternatively, sills may be Pressure Treated Douglas Fir #2 w/AWPB stamp.

11. Plywood used for structural purposes shall conform to the requirements of PS-1 and each panel shall be legibly identified as to type, grade and species by the appropriate grade trademark of the American Plywood Association. Unless otherwise noted on the structural drawings the grades shall be Structural 1, exterior type.

12. Nails shall be common wire nails, except "Stronghold" serrated nails shall be used in ceiling stripping where ceiling area is plastered. Exterior redwood shall be fastened with aluminum or galvanized nails. See 2.11.

13. Bolts, Lag Screws and Screws WS shall be commercial grade steel. See 2.11.

2.3 THIN GAUGE METAL FASTENERS

A. Thin gauge metal fasteners shall be “Strong-Tie” as manufactured by Simpson, "Trip-L-Grip" as manufactured by Mitek and Universal Joist Hangers as manufactured by Universal Anchor Company, or Engineer approved equivalent. Size, type and nailing shall be as noted on the drawings.

2.4 MISCELLANEOUS LUMBER

A. Provide wood for support or attachment of other work including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

B. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

2.5 CONSTRUCTION PANELS

A. Construction Panel Standards: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with American Plywood Association (APA) "Performance Standard and Policies for Structural-Use Panels", Form No. E445.

B. Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.

C. Concealed APA Performance-Rated Panels: Where construction panels will be used for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements indicated for grade designation, span

rating, exposure durability classification, edge detail (where applicable) and thickness.

D. Wall Sheathing: APA RATED SHEATHING. (See Drawings.)

Exposure Durability Classification: EXTERIOR.

Span Rating: As required to suit stud spacing indicated.

E. Roof Sheathing: APA RATED SHEATHING. (See Structural Drawings.)

Exposure Durability Classification: EXTERIOR.

Span Rating: 24/0.

F. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, not less than 15/32", or in thickness indicated on the drawings.

2.6 MISCELLANEOUS MATERIALS

A. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

1. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A153).

B. Building Paper: ASTM D226, Type I; asphalt saturated felt, non- perforated, 15-lb. type.

C. Air Infiltration Barrier: Provide 6.1 mil thick fabric composed of very fine, high density polyethylene fibers with vapor transmission rate of 51.30 grams per 100 sq. in. in 24 hours; weight of 8.81 lbs. per 1000 sq. ft.; bursting strength of 105 psi; tear resistance of 32.5 lbs. for length, 24.8 lbs. for width; air porosity of 7.6 seconds; water resistance of 99.3 cm of water head.

1. Product: Subject to compliance with requirements, provide Tyvek; Textile Fibers Dept., DuPont Co.

D. Sill Sealer Gaskets: Glass fiber resilient insulation fabricated in strip form for use as a sill sealer; 1" nominal thickness compressible to 1/32"; selected from manufacturer's standard widths to suit width of sill members indicated; in rolls of 50' or 100' in length.

2.7 WOOD TREATMENT BY PRESSURE PROCESS

A. Preservative Treatment: Where lumber or plywood is indicated as "Trt-Wd" or "Treated", or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber and C9 Plywood) and of AWPB Standards listed below. Mark each treated item with the AWPB Quality Mark Requirements.

B. Pressure-treat above-ground items with water-borne preservatives to comply with AWPB LP-2. After treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 24" above finish grade.

4. Wood floor plates installed over concrete slabs directly in contact with earth.

5. See paragraph 3.8 for on site preservative treatment per CBC 2517b.

6. Pressure-treat the following with water-borne preservatives for ground contact use complying with AWPB LP-22:

Wood members in contact with ground.
Wood members in contact with fresh water.

7. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

PART 3 **PART 3 - EXECUTION**

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted to required dimensions.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown on the drawings and as required by recognized standards.

D. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required. See Drawings for additional requirements.

3.2 FRAMING

A. Walls and partitions, unless detailed otherwise, shall be framed with 2" studding of width called for.

1. Studs shall have a single bottom sill plate and double top plates. Where structural plywood is called for, bottom sill shall be 3" (nominal) in thickness. Others may be 2" (nominal) in thickness. Bearing wall sills shall be bolted to concrete with 5/8" x 12" bolts spaced 4'-0" o.c. or as shown on structural drawings with a bolt within 9" of each end. The sill shall be considered ended where cut more than 1/3 of its cross-section. Unless indicated otherwise on the drawings, sills shall be bedded continuously in cement grout at least 1/2" in thickness. Top plates shall be lapped at wall intersections and corners and splices between top and lower plates shall be staggered by not less than 4 feet.

2. Studs at openings shall be doubled at each jamb with the header over bearing on the inside (cripple) stud. Headers shall be in accordance with typical detail on the structural drawings.

3. Studs at corners and wall intersections shall be framed solid in accordance with typical structural details so as to prevent finish wall material in one room from extending into adjacent area.

4. All stud partitions or walls more than eight feet but not more than 14 feet in height shall have solid blocking not less than two inches in thickness and of the same width as the stud. Walls or partitions over 14' in height shall have two or more rows of solid blocking so located that in no case will the distance between sole plates and blocking or between lines of blocking exceed eight feet.

5. All walls and partitions shall be plumb and corners and angles solid. Blocks shall be cut-in where necessary to give nailing. Headers and trimmers shall be framed around openings in ceilings where indicated. Entire frame throughout building shall be braced and framed as indicated on drawings.

6. When indicated, stud partitions not braced with sheathing or let-in braces shall be long-angle braced at intervals of 25 feet in two directions with cut-in bridging of same size as studs run on angle of approximately 45 degrees.

7. Pipes exceeding one-third of the plate width shall not be placed in partitions used as bearing or lateral force resisting walls (except that a 2" maximum round hole will be allowed in 6" (nominal) width plates unless furred clear of the studs. Where allowed, pipes shall be placed in the center of plates using a neat hole. No notching will be allowed.

3.3 FIRE STOPS

A. Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal) and shall form an effective barrier between stories, and between a top story and roof space. Fire stops shall be used in specific locations, as follows:

B. In exterior or interior stud walls, at ceilings and floor levels.

C. In all stud walls and partitions, including furred spaces, so placed that the maximum dimensions of any concealed space is not over 10 feet.

D. Between stair stringers at top and bottom and between studs along and in line with run of stair adjoining stud walls and partitions.

E. Around top, bottom, sides and ends of sliding door pockets.

F. In spaces between chimneys and wood framing, loose noncombustible materials shall be placed in noncombustible supports, or a metal collar tightly fitted to the chimney and nailed to the wood framing may be used.

G. Any other locations not specifically mentioned above, such as holes for pipes, shafting, behind furring strips and similar places which could afford a passage for flames.

H. Fire stops, when of wood, shall be 2-inch nominal thickness.

3.4 CEILING JOISTS, GIRDERS AND BEAMS

A. Ceiling joists, girders and beams shall be placed with the crown edge up so as to compensate for natural defection. Cuts in these members shall be limited to one-fifth the depth from the top, located at point from the beam end no greater than three times the depth. Cuts in excess of this restriction or bored holes greater than 2" in diameter shall not be permitted without special provision for framing.

B. Solid bridging 2" in thickness shall be installed between joists at all points of support and at all points where flooring or sheathing is discontinuous, and as indicated on the drawings and required by governing regulations.

C. Blocking between joists and studding shall be provided at all points where gypsum board, fiberboard and plywood sheets adjoin each other or terminates at walls.

D. Blocking, furring strips, nailers and/or backing shall be provided in stud walls or ceilings for anchorage of all plumbing fixtures, light fixtures, cabinet work, lockers, cork or tack board, toilet partitions and any other equipment, materials,or specialties furnished or installed by other trades.

E. All blocking in contact with concrete shall be treated lumber, in accordance with the requirements of preservatives, below.

3.5 WOOD AND TIMBER CONNECTORS

A. All wood framing shall be securely connected together in accordance with the typical nailing schedule in the structural drawings. There shall not be less than two nails in every structural connection using nails. At least one-half of nail length shall be in member receiving point, except that 16d nails may be used in the connection of two 2" (nominal) pieces of lumber. Nails shall not be driven closer than one-half their length, nor closer to the edge of the member than one-quarter their length. Where necessary to prevent splitting of lumber or at ends of ceiling stripping, holes for nails shall be pre-drilled. Wherever possible, nails driven perpendicular to the grain shall be used instead of toe nails.

B. All bolts shall be installed in holes bored with a bit of the nominal diameter as the bolt plus 1/16" and shall have under the heads and nuts of same, where bearing on wood, malleable iron and/or steel plate washers as follows: (malleable iron washers shall have full bearing surfaces without indentations).

SIZE BOLTS	MALLEABLE IRON WASHERS	STEEL PLATE WASHERS
1/2"	2-1/2" dia. X 1/4"	2" x 2" x 1/4"
5/8"	2-3/4" dia x 5/16"	2-1/2" x 2-1/2" x 1/4"
3/4"	3" dia x 7/16"	3" x 3" x 5/16"
7/8"	3-1/2" dia x 7/16"	3-1/2" x 3-1/2" x 3/8"
1"	4" dia x 1/2"	3-3/4" x 3-3/4" x 3/8"

Nuts on bolts shall be tightened at the time of installation, re-tightened before covering up end, and for any accessible locations, re-tightened before final acceptance.

C. Lag or wood screws shall be screwed and not driven into place. The hole to receive the screw shall first be bored of the same diameter of the shank, after which the hole shall be continued to depth equal to length of screw with diameter equal to of screw at roof of thread. The screw shall penetrate two-thirds of its length into the far member.

3.6 RAFTER AND CEILING JOIST FRAMING

A. Ceiling Joists: Provide member size and spacing shown, and as previously specified for floor joist framing. Face nail to ends of parallel rafters.

1. Where principal ceiling joists are at right angles to rafters, frame as indicated with additional short joists from wall plate to first joist; nail to ends of rafters and to top plate and nail to long joists or anchor with framing anchors or metal straps. Provide 1 x 8 or 2 x 4 stringers spaced 4 feet o.c. crosswise over principal ceiling joists.

B. Rafters: Provide member size and spacing shown. Notch to fit exterior wall plates and toe nail or use special metal framing anchors. Double rafters to form headers

and trimmers at openings in roof framing (if any), and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide valley rafter of size shown, or if not shown, provide rafter twice as thick as regular rafters and 2" deeper. Bevel ends of jack rafters for full bearing against valley rafter.

2. At hips, provide hip rafters of size shown, or if not shown, provide of same thickness as regular rafters and 2" deeper. Bevel ends of jack rafters for full bearing against hip rafters.

C. Provide collar beams (ties) as shown, or if not shown, provide 1" x 6" boards between every third pair of rafters. Locate below ridge member, one-third of distance to ceiling joists. Cut ends to fit slope and nail to rafters.

D. Provide special framing as shown for eaves, overhangs, dormers and similar conditions, if any.

3.7 PRESERVATIVE

A. Except for Redwood sills, all wood in exterior walls entering or resting upon concrete or masonry walls, curbs or slabs, the top of which is less than two feet above the level of outside finished grade adjacent to the building, shall be pressure treated for a distance of 6 in. min. from the concrete. The treatment shall be completed at least two hours prior to incorporating the wood in the building. Where such treatment is given, a backing of building paper shall be installed over treated material before the application of plaster or gypsum board. Preservative to be water borne salt preservative, non-corrosive, paintable, odorless; "Osmose K-33" (Chromated Copper Arsenate, Type B) or approved equal. Pieces which are cut, bored or notched, to be treated per CBC 2517b.

3.8 INSTALLATION OF CONSTRUCTION PANELS

A. General: Comply with applicable recommendations contained in Form No. E 30F, "APA Design/Construction Guide – Residential & Commercial," for types of construction panels and applications indicated. Specifically refer to nailing schedule in the Structural Drawings.

B. Fastening Methods: Fasten panels as indicated below:

1. Sheathing: Nail to framing.

C. Plywood Backing Panels: Nail to supports.

3.9 AIR INFILTRATION BARRIER

A. Cover wall sheathing with air infiltration barrier to comply with manufacturer's printed directions.

3.10 CLEAN UP

A. All debris and/or rubbish resulting from the operation of this trade shall be cleaned up and removed from the site as the work progresses.

END SECTION

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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 06 10 00 – Rough Carpentry

C. 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 gauge.

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."

2.4 HARDWARE

A. Each door shall be furnished with the following:

Item	Number Required	Manufacturer and Catalog No.
Butts	3	Stanley, FBB 191-630 4 ½ x 4 ½ NRP
Lockset		Simplex L1000 series
Cylinder		Schlage, 20-001-630 with cover as required by lock furnished.

B. Equivalent products of other manufacturers will be considered subject to approval by Engineer.

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 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 as indicated in the Contract Documents.

B. All labor, materials, tools and equipment, and incidentals necessary and required for their completion.

C. All coatings for potable water service shall be ANSI-NSF Standard 61 certified.

1.2 RELATED WORK

A. Section 03 30 01 – Cast-in-Place Concrete

B. Section 05 50 00 – Fabricated Metal

C. Section 06 10 00 – Rough Carpentry

D. Division 11 – Equipment

E. Division 23 – Mechanical

F. Division 26 – Electrical

G. Division 40 – Process Integration

H. Division 43 – Process Gas and Liquid Handling

I. Division 46 – Water and Wastewater Equipment

1.3 SUBMITTALS

A. Shop Drawings, Product Data, and Samples: as specific in Section 01 33 00 – Submittals.

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.

1.4 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 74.2 of the Ventura County Air Pollution Control District shall apply to this project. The manufacturers' products listed in paragraphs 3.01 and 3.02 of this section have been selected on the basis of their apparent compliance; 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 the Ventura County Air Pollution Control District Rule 74.2, 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.

1.5 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.

1.6 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.

1.7 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 – Submittal Procedures.

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 generally 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.

1.8 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 fume-proof. 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 ALUMINUM SURFACES

A. All aluminum in contact with steel or concrete: Sherwin Williams "Macropoxy 646 FC Epoxy B58-600 series or approved equivalent.

2.6 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.

2. Polished or finished stainless steel. Unfinished stainless steel shall be painted.

3. Nameplates

4. Nickel or chromium.

5. Galvanized surfaces, except piping, conduit, electrical conduit, pipe supports, fasteners, hangers, bracing, brackets, and accessories.

6. Rubber and plastics, including fiberglass reinforced plastics.

7. Precast concrete.

2.7 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 ½-inch 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.

2.8 PIPING IDENTIFICATION

A. Pipe shall be color coded as directed by the Owner

B. Electrical conduit shall be painted to match adjacent ceiling or wall surfaces as directed by the Engineer.

C.

Item	Paint Color
Valve handwheels and levers	Red

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 50º F, or when the temperature of the air, surface to be painted or substrate, is below (or likely to fall below) 50º 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 five 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	SP-2 or 3	P-2	F-2	F-2

	mechanical and structural items.				
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	

		FINISH			
SYSTEM	SURFACE	SURF. PREP.	PRIME COAT	2ND COAT	3RD COAT
7.	All new buried valves and flanged joints and other buried miscellaneous ferrous piping and metal surfaces (excluding case 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 CONFLICTS

A. When conflicting painting specifications or requirements are encountered in the contract documents, the more restrictive specifications or requirements shall be required.

END SECTION

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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, pipe couplings, and steel pipe.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 90 00 – Painting and Coating

B. Division 40 – Process Integration

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 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 34.23404 latitude and -118.93059 longitude.

B. The Risk Categories are as follows:

1. All facilities for this project are needed for fire suppression and public utility facilities required for emergency backup for other essential facilities and shall be considered essential facilities – Risk Category IV.

2. 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=1.665

E. The mapped spectral acceleration for 1-second period, S_1=0.613

F. The site coefficient F_a=1.000

G. The site coefficient F_v=1.700

H. The maximum considered earthquake acceleration for short periods, S_{MS}=1.665

I. The maximum considered earthquake acceleration for 1-second period, S_{M1}=1.042

J. The design spectral acceleration for short periods, S_{DS}=1.110

K. The design spectral acceleration for 1-second period, S_{D1}=0.695

L. The site short period, T_s=0.626

M. The site long period, T_L=8

N. The project area is Site Class D.

O. Site Specific Data per ASCE Section 21.4 are as follows:

1. S_{DS}= 1.238

2. S_{D1}= 1.183

3. PGA = 0.725

P. 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.

Q. Non-Building Structures Design

1. Seismic design of non-building structures shall be in conformance with ASCE 7 Chapter 15.

R. 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 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 Division 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 Division 01.

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 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
   a. Refer to Division 01.

1.04 SUBSTITUTIONS

1. Refer to Division 00.

1.05 CHANGE ORDER PROPOSALS

A. Refer to Division 00.

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 26 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 01 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 01 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 Section 00 65 36.

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, 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.

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, be color-coded and marked with gauge, type and manufacturer's name on 24" centers.

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. Splicing of conductors shall only be allowed when approved by the District.

B. Join and terminate wire, conductors and cables in accordance with UL 486, CEC and manufacturer's instructions.

C. Thoroughly clean wires before installing lugs and connectors.

D. Make splices, taps and terminations to carry full conductor ampacity without perceptible temperature rise, and shall be made mechanically and electrically secure.

E. Terminate wires in terminal cabinets using terminal strips, unless otherwise indicated.

F. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere within panel or cabinet.

G. Encapsulate splices in wet locations using specified insulating resin kits.

H. 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.

I. 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.

J. Branch circuits (#10 AWG and smaller) connectors shall comply with 2.03.A and 2.03.B above.

K. 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.

L. 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.

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. Aluminum rigid conduit (ARC)

a. Conduit: Same as rigid steel conduit except Type 6063 aluminum alloy, T-1 temper.

b. Fittings (couplings, elbows, bends, etc.): Same as rigid steel conduit except Type 6063 aluminum alloy, T-1 temper.

c. Bushings: Same as rigid steel conduit except Type 6063 aluminum alloy, T-1 temper.

3. Stainless steel conduit (SSC)

a. Conduit: Same as rigid steel conduit except Type 304 stainless steel.

b. Fittings (couplings, elbows, bends, etc.): Same as rigid steel conduit except Type 304 stainless steel.

c. Bushings: Same as rigid steel conduit except Type 304 stainless steel.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.

11. 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 or cast aluminum 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.

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 1” in underground application or 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

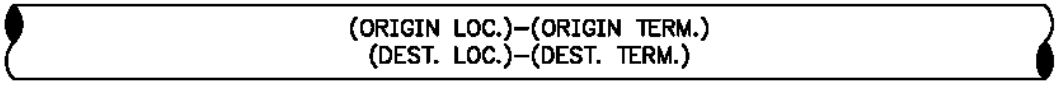
A. Nameplates:
   1. Provide a nameplate for each control device or major item of electrical equipment, either located in the field or within panels.
   2. Provide all nameplates of identical style, color, and material throughout the facility.
   3. Device nameplates information:
      a. Designations 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 Section 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 good outstanding 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 Section 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.

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 stand alone, 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

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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)

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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. IEM per District's standards.

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

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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. IEM per District's standards.

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 white, ANSI GI, 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 current density ratings. 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 or lock 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

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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. IEM per District's standards.

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 with 3 point latch system and equipped with a handle that accepts a padlock. 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

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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– I&C - 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 – Low Voltage Transformer - Dry-Type
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 also be the manufacturer of the across the line motor starters, solid state reduced voltage starters and variable frequency drives. The use of third party supply and assembly is not acceptable and will be rejected.

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. Rockwell Automation Allen-Bradley Centerline 2100 with IEM exterior per District's standards.

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 1 Gasketed 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 white. 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.

G. Unit Information
   1. Each vertical section shall accommodate six size No. 1 combination starter spaces or “buckets” within each vertical section. Only one-half of full multiples of this unit space shall be used for the various types and sizes of equipment in the MCC. Starters and other equipment shall be arranged on the front only.
   2. Construction shall be NEMA Class II to provide complete systems wiring and individual combination motor starter units shall be Type B with unit mounted terminal blocks.
   3. NEMA Size 5 starters and below shall be provided as plug-in units.
   4. Plug-in units
      a. Plug-in units shall consist of unit assembly, unit support pan and unit door assembly.
      b. Units shall be supplied with removable doors. The unit doors shall be fastened to the structure so that the doors can be closed when the unit is removed.
      c. A unit support pan shall be provided for support and guiding units. Unit support pans shall remain in the structure when units are removed to provide isolation between units.
      d. A service position shall be provided for plug-in units that allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position.
   5. Power Stabs
      a. Unit stabs for engaging the power bus shall be tin plated copper and provided with stainless back-up springs to provide and maintain a high pressure 4-point connection to the vertical bus.

b. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed to the rear of the unit. A separate isolated pathway shall be provided for each phase to minimize the possibility of unit fault conditions reaching the power bus system.

c. The power cable termination at the plug-in stab shall be a maintenance free crimp type.

6. 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.

7. Pilot Devices

a. Where specified, units shall be furnished with NEMA Type 4/13 water tight / oil tight pushbuttons, selector switches or pilot lights.

8. Terminal Blocks

a. Control terminal blocks shall be pull-apart on all plug-in units for easy removal of the unit from the structure.

b. Control terminal blocks on factory mounted units shall be fixed type.

c. Provide power terminal blocks on starters rated NEMA size 3 and below. Power terminal blocks shall be pull-apart for NEMA size 1 and 2. Terminal blocks for NEMA size 3 starters shall be non-pull apart. Power terminal blocks are not required on NEMA size 4 and above.

d. Terminal blocks shall not be located adjacent to or inside the vertical wireway.

2.05 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. Vertical Bus

1. The vertical power bus shall have an effective rating of 600A. If a center horizontal bus construction is utilized, then the rating shall be 300A above and below the horizontal bus for an effective rating of 600A. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600A.
2. The vertical bus material shall be copper with tin plating.
3. The vertical bus shall attach to the horizontal bus with at least 2 bolts.
4. The vertical bus shall be continuously braced by a high strength non-tracking glass-filled polyester material and sandwiched by a glass-filled polycarbonate molded cover.
5. Automatic shutters shall cover plug-in stab openings when units are removed.

C. 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.

D. 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.

2.06 ETHERNET/IP COMMUNICATION

A. The MCC shall have Ethernet wiring incorporated into its design.
    1. The MCC shall have factory installed industrial Ethernet cabling incorporated throughout the vertical section across the entire lineup
    2. Each motor starter, electronic overload relay, power monitor, AC drive, and soft starter unit in the MCC shall be supplied with a means to communicate via EtherNet/IP network
    3. Plug-in units should be able to move around without impacting the network
    4. Maintenance activities should be able to be performed without impacting the network

B. Industrial Ethernet Switch.
    1. The MCC shall have managed industrial Ethernet switch(s) with Ports to connect each EtherNet/IP enabled device.
    2. Ethernet Switches shall be provided with spare ports to accommodate network expansion and future plug-in unit inserts.
    3. The managed industrial Ethernet switch shall deliver optimal network security, network resiliency (if needed), and flexibility. The functionality should include port based control/prioritization, switch-level ring support, VLAN segmentation, and other Layer-2 switch features.
    4. The managed industrial Ethernet switch shall have the ability to include, if needed, Gigabit ports, CIP Sync functionality, Network Address Translation (NAT), and an Industrial SD Card.
    5. The managed industrial Ethernet switch shall include redundant terminal blocks for customer supplied/connection of an external 24V DC UPS.

C. Industrial Ethernet Switch Layout.
    1. Layout – Fixed-Mount Switch Unit
        a. The managed industrial Ethernet Switch shall be mounted in a fixed-mount, Switch Unit in the top of the section.
        b. The industrial Ethernet cable shall connect each switch to one another in a linear topology
        c. The Switch Unit shall be provided with a locking latch.
        d. The Switch Unit shall be provided with a door mounted viewing window.
        e. The Switch Unit shall be provided with a door mounted external network connector.

D. Industrial Ethernet Cabling.
    1. Industrial Ethernet Cable Ratings
        a. The industrial Ethernet cable shall be 600V UL Category 5e PLTC rated
        b. b) The use of a 300V rated cable is not acceptable
        c. c) Ethernet Switch-to-Device cable labels shall be located on both ends of the cable to specify where the cable is connected to on both ends

d. d) A detailed Ethernet network table and Ethernet network diagram specifying IP addresses, subnet masks, device locations, cable label details, and 24V DC capacities shall be included in the MCC documentation.

2. Layout – Homerun (direct switch-to-device) Ethernet Connections.
   a. An industrial Ethernet cable shall be routed from the managed industrial Ethernet Switch directly to the EtherNet/IP device in each unit.
      1) The industrial Ethernet cable shall be routed through the top or bottom horizontal wireway and transition through the vertical wireway directly to the EtherNet/IP device.
      2) The industrial Ethernet cable shall be secured to vertical wireway tie bars.
   b. he EtherNet/IP device within each unit shall be factory connected to the industrial Ethernet switch directly by using a 600V – UL rated Category 5e PLTC rated industrial Ethernet cable.
3. Power Supplies.
   a. Power supplies shall provide 24V DC for the devices that require it
   b. The MCC manufacturer shall check the user's design to confirm that adequate power supplies have been specified to conform with network requirements
   c. Power supply output shall be rated 8 A, 24V DC
   d. Power supplies shall be Allen-Bradley Bulletin 1606-XLS240E or approved equal
   e. Power supply units shall be provided with a buffer module to provide a minimum of 500 ms ride-through at full load (the buffer module is optional for the standard Ethernet power supply)
   f. Buffer modules shall be Allen-Bradley Bulletin 1606-XLBUFFER or approved equal
   g. Two (2) 24V DC adapters allowing four (4) power connections shall be provided:
      1) In each vertical wireway of standard sections to simplify installation, relocation and addition of plug-in units
      2) Each 24V DC adapter in the vertical wireway shall be connected to the power supply
   h. The power supplies units shall be provided with a door mounted external 120V AC connection for laptop power and Ethernet network connection.
   i. Redundant 24V DC power shall be provided for all Ethernet enabled devices. Choose one type of 24V DC redundancy for the MCC application as they are mutually exclusive:
      1) A Redundancy Unit shall be included that provides the capability of interconnecting two independent power supplies in a redundant way (N+1) and whose output is connected to the 24V DC circuit. The Redundancy Unit shall be powered by one of the following options:
         a) Two Rockwell Automation-supplied 24V DC power supply units

b) One Rockwell Automation-supplied 24V DC power supply unit and one external power input provided by the customer

c) Two external 24V DC power inputs provided by the customer

2) Two 8 A power supply modules shall be placed in the same power supply unit and wired in parallel with blocking diodes whose output is connected to the 24V DC circuit.

E. EtherNet/IP Interface for Motor Starter Units.

1. Motor starter units shall have an electronic overload relay that incorporates the following features:

a. Built-in EtherNet/IP communication

b. Overload relay powered by 120V AC

c. Status indicators for status indication

d. Test/Reset button

e. Selectable trip of NEMA Class 5 to 30. Unless indicated, the trip class shall be set for NEMA Class 20 operation

f. Up to six (6) inputs and three (3) outputs of direct I/O. Additional I/O can be provided with an add-on module to the overload relay. Input voltage shall match the overload relay power voltage

g. Protective functions

1) Functions shall provide a programmable trip level, warning level, time delay, and inhibit window

2) Protective functions shall include Thermal overload, Phase loss, Stall, Jam, Underload, Current imbalance, Remote trip, and PTC thermistor input

3) Ground fault protection is not required

4) PTC Thermistor input is required were stated within the pump motor

5) Voltage protection is required

a) Input fusing shall not be used on NEMA 3 and smaller starters

h. Current monitoring functions shall include phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized, and ground fault current (if required)

i. Voltage, energy, and frequency measuring capabilities shall be included when voltage protection is required

j. Diagnostic information shall include device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips

k. Preventive maintenance information shall include Allowable starts per hour, required Time between starts, Starts counter, Starts available, Time until next start, total operating hours, and elapsed operating time

l. Overload relay shall include an on-board logic processor to allow basic logic to be performed within the overload relay based on network data and the status of the inputs to the overload relay

m. The overload relay shall support the following CIP messaging types: Polled I/O messaging, Change-of-state/cyclic messaging, Explicit messaging, Group 4 offline node recovery messaging, and Unconnected Message Manager (UCMM)

n. The overload relay shall provide the following functions to minimize network configuration time: Full parameter object support, Configuration consistency value, and Add-on Profile

2. The overload relay shall be Allen-Bradley E300™ model or approved equal

F. EtherNet/IP Interface for Variable Frequency AC Drives and Solid-State Reduced Voltage Motor Controllers.

1. The EtherNet/IP communication interface shall be supplied to allow for communication between the solid-state component and the Ethernet network

G. EtherNet/IP Interface for Other Units.

1. Provide an EtherNet/IP interface for other units as indicated on the contract drawings 2. Refer to the contract drawing wiring diagrams for points to be monitored

H. Programming and Testing.

1. The MCC manufacturer shall load the IP Address and Subnet Mask into each unit and Ethernet switch

2. The IP Address shall be as indicated on the contract drawings or as provided by the contractor

3. The MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment

4. Each unit shall have a label showing the IP Address for the devices within it

5. The MCC manufacturer shall provide a disk containing applicable electronic data sheet (EDS) files for the EtherNet/IP devices

6. The IP Address shall not be visible on the unit Nameplate for any units containing an EtherNet/IP enabled device

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 28 11 – Overcurrent Protection Devices.

E. Circuit breaker disconnect assemblies specified in Drawings shall comply with Section 26 28 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.

E. Provide a door mounted selector switch for Hand-Off-Auto operation. The Hand Mode shall provide local start control. In the Auto Mode, start control shall be provided through a remote contact. Provide an extra set of contacts on the selector switch for monitoring of switch position.

F. Provide door mounted transformer type pilot lights for On (Green) and Off (Red) indication.

2.09 SOLID STATE MOTOR CONTROLLERS (SSMC)

A. The unit shall be provided with overcurrent protection and disconnect device as shown on Drawing.

B. The unit shall be provided with a 120V control power transformer. The control power transformer shall be provided with primary and secondary fusing.

C. The SSMC unit shall be provided with a bypass contactor for NEMA 12 designs. The bypass contactor shall be energized once the motor is up to full speed. The bypass contactor shall be fully rated for the motor load and be capable of starting the motor if so wired in the field. The unit shall be provided with a converter module so that the SSMC overload can be utilized at all times.

D. Provide an input isolation contactor.

E. The SSMC unit shall be provided with line side protective modules. The modules shall contain capacitors and metal oxide varistors (MOVs) that protect the internal power circuitry from severe electrical transients and / or high electrical noise.

F. Provide a door mounted selector switch for Auto-Manual control. In the auto mode, the start command shall be provided through a remote contact. In the manual mode,

the start-stop control shall be provided through the door mounted push buttons. Provide extra contact blocks on the selector switch for monitoring of switch position.

G. Provide door mounted pushbuttons for start-stop and pump stop control. Stop pushbuttons shall always be active.

H. Provide door mounted transformer type pilot lights for indication of On (Green) and Off (Red).

2.10 VARIABLE FREQUENCY DRIVES

A. The unit shall be provided with overcurrent protection and disconnect device as shown on Drawing.

B. The unit shall be provided with a 120V control power transformer. The control power transformer shall be provided with primary and secondary fusing.

C. Provide a 120V control interface.

D. Provide a common mode choke on the output of the drive.

E. Provide a door mounted selector switch for Auto-Manual control. In the auto mode, the start command shall be provided through a remote contact. In the manual mode, the start-stop control shall be provided through the PLC in a similar fashion. Provide extra contact blocks on the selector switch for monitoring of switch position.

F. Provide door mounted pushbuttons for stop control. Stop pushbuttons shall always be active. Maintained stop push button breaks VFD enable run circuit. Provide extra contact block for monitoring, normally open start stop button.

G. Provide door mounted transformer type pilot lights for indication of On (Green) and Off (Red).

H. Provide a door mounted Human Interface for programming, display and speed control.

I. Provide one isolated / configurable analog input and output.

2.11 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.

2.12 LIGHTING PANEL

A. Provide distribution panel as shown on the Drawings and per Section 26 24 16 – Panelboards.

2.13 SOFTWARE

A. Preconfigured Software.
   1. Software shall be capable of viewing multiple MCC lineups
   2. Software communication driver shall allow the software to be installed and operated on the EtherNet/IP or DeviceNet network
   3. Software shall be capable of functioning as a standalone software package or as an ActiveX control in a Human Machine Interface (HMI)
   4. Software shall be capable of displaying the following
      a. Elevation View
         1) Dynamically displays status information based on reading data from devices in the MCC lineup
         2) Sizeable graphical/virtual representation to allow ease of viewing multiple MCC lineups
         3) Unit nameplate information
         4) Unit status indicators (ready, running, warning, fault, no communication)
         5) Should be able to add devices, move devices, add sections and move sections
      b. Unit Monitor View
         1) Preconfigured for a specific unit
         2) Real-time monitoring via real-time analog dials, parameter value display, and data trending
         3) Data configurable for customized viewing
         4) Modifying device parameters
         5) Data trend export functionality to .csv file
      c. Spreadsheet View
         1) User configurable for customized monitoring displaying maximum information about the lineup
         2) Sorting and cascading functions iii. Custom user fields
      d. Event Log
         1) Track history of MCC unit
         2) Automatic logging of trips, warnings, and changes iii. Manual entry of events
      e. Documentation
         1) Front elevation drawings
         2) Unit wiring diagrams

3) User manuals

4) Spare parts lists

5) Ability to add and/or update documentation

f. Integration Assistant

1) Integrate the MCCs into the PLC software and generate required tags and IP address configurations for devices:

a) Choose from device_IP address or Nameplate_IP address for tag naming convention

b) Ability to map devices to any EtherNet/IP communication cards in the PLC I/O chassis

2) Integrate the MCCs with energy monitoring software and display real-time device energy consumption data directly in preconfigured software

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 indicated on Drawings. Provide all testing and inspections requirements by inspecting authority.

B. Installation shall conform to NECA 402 where not specified under this Division.

C. Tighten accessible bus connection and mechanical fasteners after placing motor control center.

D. The MCC shall be connected ABC counter clock wise rotation (CCW) unless otherwise directed by the District. The VFD's shall be connected to the motors so that the VFD's run counter clock wise rotation (CCW) as their "forward / normal direction" with reverse locked out (disabled).

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. Insure 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

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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. Allen-Bradley – PowerFlex 755 VFD or approved equal

2.02 VARIABLE FREQUENCY DRIVE UNIT

A. Features

1. Certifications

a) Listed to UL508C and CAN/CSA-C22.2 No. 14-05
b) In conformity with EMC Directive (2004/108/EC) and Low Voltage Directive (2006/95/EC). Standards applied; EN 61800-3:2004, EN 61800-5-1:2007
c) TÜV Rheinland - standards applied: EN 61800-3:2004, EN 61800-5-1:2007, EN ISO 13849-1:2008, EN ISO 13849-2:2003, EN 61800-5-2:2007, EN 61508
PARTS 1-7:2000, EN 62061:2005, and EN 60204-1:2006
d) Australian Communications and Media Authority. In conformity with Radiocommunications Act: 1992, Radiocommunications Standard: 2008, and Radiocommunications Labeling Notice: 2008. Standards applied:
EN 61800-3:2004

e) Electric Power Research Institute. Certified compliant with standards SEMI F47 and IEC 61000-4-34
f) Russian GOST-R Certificate No. POCC US.ME92.H00040

2. Hardware

a) Utilize diode bridge or SCR bridge on the input rectifier.
b) Utilize DC bus inductor on all six-pulse VFDs only.
c) Utilize switching logic power supply operating from the DC bus.
d) Incorporate phase to phase and phase to ground MOV protection on the AC input line.
e) Utilize gold plated plug-in connections on printed circuit boards.
f) Microprocessor based inverter logic shall be isolated from power circuits.
g) Utilize latest generation IGBT inverter section.
h) Inverter section shall not require commutation capacitors.
i) Embedded Ethernet port for direct network cable connections.
j) Battery receptacle for Lithium battery power to the Real Time Clock.
k) Additional DPI port for handheld and remote HIM options.
l) Dedicated Digital Input for hardware enable.
m) Conformal coated printed circuit boards.
n) Optional onboard 24V DC Auxiliary Control Power Supply.

3. Control Logic

a) Ability to operate with motor disconnected.
b) Provide a controlled shut down, when properly protected, with no component failure in the event of an output phase to phase or phase to ground short circuit. Provide annunciation of the fault condition.
c) Provide multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.
d) Provide multiple acceleration and deceleration rates.
e) Adjustable output frequency up to 650Hz.

4. DeviceLogix Control

a) Ability to control outputs and manage status information locally within the VFD.
b) Ability to function stand-alone or complimentary to supervisory control.
c) Ability to speed reaction time by processing in the VFD.
d) Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.
e) Ability to read inputs/write outputs and exclusively control the VFD.
f) Ability to provide an option for decision making if communication is lost with main controller.
g) Ability to control other VFDs via a peer-to-peer EtherNet/IP network.
h) Ability to write programs off-line.

5. Motor Control Modes

a) Selectable Sensorless Vector, Flux Vector, V/Hz, Permanent Magnet Motor, and Adjustable Voltage Control modes selectable through programming.

b) The drive shall be supplied with a Start-up and Auto-tune mode.
c) The V/Hz mode shall be programmable for fan curve or full custom patterns.
d) Capable of Open Loop V/Hz.

6. Current Limit

a) Programmable current limit from 20 to 160% of rated output current.
b) Current limit shall be active for all drive states: accelerating, constant speed and decelerating.
c) The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.

7. Acceleration / Deceleration

a) Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 to 3600 seconds.
b) A second set of remotely selectable accel/decel settings shall be accessible through digital inputs.

8. Speed Profiles

a) Programming capability shall allow the user to produce speed profiles with linear acceleration/deceleration or "S Curve" profiles that provide changing accel/decel rates.
b) S Curve profiles shall be adjustable.

9. Adjustments

a) A digital interface can be used for all set-up, operation and adjustment settings.
b) All adjustments shall be stored in nonvolatile memory (EEPROM).
c) No potentiometer adjustments shall be required.
d) EEPROM memory for factory default values shall be provided.
e) Software must be available for trending and diagnostics, as well as online and offline programming functionality.

10. Process PID Control

a) The drive shall incorporate an internal process PI regulator with proportional and integral gain adjustments as well as error inversion and output clamping functions.
b) The feedback shall be configurable for normal or square root functions. If the feedback indicates that the process is moving away from the set-point, the regulator shall adjust the drive output until the feedback equals the reference.
c) Process control shall be capable of being enabled or disabled with a hardwire input. Transitioning in and out of process control shall be capable of being tuned for faster response by preloading the integrator.
d) Protection shall be provided for a loss of feedback or reference signal.

11. Skip Frequencies

a) Three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance shall be provided.
b) The set points shall have a bandwidth adjustable from Maximum Reverse Speed to Maximum Forward Speed.

12. Fault Reset / Run

a) The drive shall provide up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.
b) The automatic mode shall not be applicable to a ground fault, shorted output faults and other internal microprocessor faults.
c) The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

13. Run on Power Up

a) A user programmable restart function shall be provided to allow restart of the equipment after restoration of power after long duration power outages. Restart time dependent on presence of incoming signal.

14. Fault Memory

a) The last 32 fault codes shall be stored and time stamped in a fault buffer.
b) Information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and twenty-seven other status conditions shall be stored.
c) A power-up marker shall be provided at each power-up time to aid in analyzing fault data.
d) The last 32 alarm codes shall be stored and time stamped for additional troubleshooting reference.

15. Overload Protection

a) The drive shall provide internal class 10 adjustable overload protection.
b) Overload protection shall be speed sensitive and adjustable.
c) A viewable parameter shall store the overload usage.

16. Auto Economizer

a) An auto economizer feature shall be available to automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage.
b) When the load increases, the drive shall automatically return to normal operation.

17. Terminal Blocks

a) Separate terminal blocks shall be provided for control and power wiring.
b) I/O terminal blocks shall be removable with wiring in place.

18. Flying Start

    a) The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. This feature is disabled by default.

19. Inputs and Outputs

    a) The Input / Output option modules shall consist of both analog and digital I/O.
    b) No jumpers or switches shall be required to configure digital inputs and outputs.
    c) All digital input and output functions shall be fully programmable.
    d) The control terminal blocks shall be rated for 115V AC.
    e) Inputs shall be optically isolated from the drive control logic.
    f) The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.
    g) The VFD shall be capable of supporting up to 10 analog inputs, 10 analog outputs, 31 digital inputs, 10 relay outputs, 10 transistor outputs, and 5 positive temperature coefficient (PTC) inputs.
    h) The Input / Output option modules shall have the following features:

        i. Analog Inputs:

            a. Quantity two (2) differentially isolated, ±10V (bi-polar), 88k ohm input impedance, 11 bit plus sign.
            b. Analog inputs shall be user programmable for a variety of uses including frequency command and process loop input. Analog inputs shall be user programmable for function scaling (including invert), offset, signal loss detect and square root.

        ii. Analog Outputs:

            a. Quantity two (2) ±10V (bi-polar) / 11 bit & sign, 2 kΩ minimum load, 4-20 mA, 11 bit plus sign, 400 Ω maximum load.
            b. The analog output shall be user programmable to be proportional to one of fourteen process parameters including output frequency, output current, encoder feedback, output power.
            c. Programming shall be available to select either absolute or signed values of these parameters.

        iii. Digital Inputs:

            a. Quantity of six (6) digital inputs rated 24V DC/115V AC.
            b. All inputs shall be individually programmable for multiple functions including: Start, Run, Stop, Auxiliary Fault, Speed Select, Jog and Process PI functions.

        iv. Digital Outputs:

            a. At least one (1) relay output (N.O. or N.C.).
            b. For 240V AC or 24V DC, N.O. contact output ratings shall be 2

amp max., general purpose (inductive)/resistive. N.C. contact output ratings shall be 2 amp max., resistive only.

c. Relays shall be programmable to multiple conditions including: Fault, Alarm, At Speed, Drive Ready and PI Excess Error.

d. Timers shall be available for each output to control the amount of time, after the occurring event, that the output relay actually changes state.
e. At least one (1) transistor output.
f. For 24V DC, transistor output rating shall be 1 amp max, Resistive.

20. Reference Signals

a) The drive shall be capable of using the following input reference signals:

i. Analog inputs
ii. Preset speeds
iii. Remote potentiometer
iv. Digital MOP
v. Human Interface Module
vi. Communication modules

21. Loss of Reference

a) The drive shall be capable of sensing reference loss conditions.
b) In the event of loss of the reference signal, the drive shall be user programmable to the following:

i. Fault the drive and coast to stop.
ii. Issue a minor fault - allows the drive to continue running while some types of faults are present.
iii. Alarm and maintain last reference.

c) When using a communications network to control the drive, the communications adapter shall have these configurable responses to network disruptions and controller idle (fault or program) conditions:

i. Fault
ii. Stop
iii. Zero Data
iv. Hold Last State
v. Send Fault Configuration

22. Metering

a) At a minimum, the following parameters shall be accessible through the Human Interface Module, if installed:

i. Output Current in Amps
ii. Output Voltage in Volts
iii. Output Power in kW
iv. Elapsed MWh

v. DC Bus Voltage
vi. Frequency
vii. Heatsink Temperature
viii. Last eight (32) faults
ix. Elapsed RunTime
x. IGBT Temperature

23. Faults

a) At a minimum, the following faults shall be accessible through the Human Interface Module:

i. Power Loss
ii. Undervoltage
iii. Overvoltage
iv. Motor Overload
v. Heat Sink Over-temperature
vi. Maximum Retries
vii. Phase to Phase and Phase to Ground Faults

24. Predictive Diagnostics

a) At a minimum, the following predictive diagnostic features shall be provided:

i. Relay Output Life Cycles based on load type and amps.
ii. Hours of Fan Life based on load and ambient temperature.
iii. Motor Bearing life based on expected hours of use.
iv. Motor Lubrication schedule based on hours of use.
v. Machine Bearing life based on expected hours of use.

25. Real-Time Clock

a) Shall be capable of providing time stamped events.
b) Shall have the ability to be set locally or via a remote controller.
c) Shall provide the ability to be programmable for month, day, year and local time zones in HH:MM:SS.

2.03 VFD PACKAGED SYSTEM

A. Features

1. Ratings

a) Voltage

i. Capable of accepting nominal plant power of 480V AC at 60Hz.
ii. The supply input voltage tolerance shall be ± 10% of nominal line voltage.

b) Displacement Power Factor

i. Six-pulse VFD shall be capable of maintaining a minimum true power

factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.

ii. Eighteen-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.98 or better at rated load and nominal line voltage, over the entire speed range.

c) Efficiency

i. A minimum of 96.5% (+/- 1%) at 100% speed and 100% motor load at nominal line voltage.

ii. Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.

d) Operating ambient temperature range without derating: 0 °C to 40 °C (32 °F to 104 °F)

e) Operating relative humidity range shall be 5% to 95% non-condensing.

f) Operating elevation shall be up to 1000 Meters (3,300 ft) without derating.

2. Sizing

a) Systems rated at Normal Duty loads shall provide 110% overload capability for up to one minute and 150% for up to 3 seconds.

b) Systems rated at Heavy Duty loads shall provide 150% overload capability for up to one minute and 180% for up to 3 seconds.

3. Auto Reset/Run

a) For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.

4. Ride-Through

a) The VFD system shall attempt to ride through power dips up to 20% of nominal. The duration of ride-through shall be inversely proportional to load. For outages greater than 20%, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.

5. Run on Power Up

a) The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration the process controller will attempt to clear any faults and issue a run command, if desired.

6. Communications

a) VFD shall provide an embedded EtherNet/IP port.

b) VFD shall be capable of communicating on multiple networks.
c) VFD shall be capable of supporting the following network options:

i. DeviceNet
ii. EtherNet/IP
iii. ControlNet Coax
iv. ControlNet Fiber
v. Interbus
vi. CANopen
vii. Modbus/TCP
viii. Modbus RTU
ix. Profibus DP
x. RS-485 DF1
xi. RS-485 HVAC
xii. Remote I/O

7. Enclosure Door Mounted Human Interface Module (HIM)

a) VFD shall provide a HIM with integral LCD display, operating keys and programming keys.
b) An enclosure door-mounted HIM NEMA/UL Type 4/12, shall be provided.
c) An optional VFD-mounted HIM, rated NEMA/UL Type 1, may be provided and shall be capable of connecting via a separate cable for use as a handheld terminal.
d) The HIM shall have the following features:

i. A seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.
ii. Shall indicate drive operating conditions, adjustments and fault indications.
iii. Shall be configured to display in the following three distinct zones:

a. The top zone shall display the status of direction, drive condition, fault /alarm conditions and Auto / Manual mode.
b. The middle zone shall display drive output frequency.
c. The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.

iv. Shall provide digital speed control.
v. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

B. Enclosure

1. Shall be rated NEMA/UL Type 12.
2. Shall be painted per the manufacturer’s standard.
3. Shall provide entry and exit locations for power cables.
4. Shall contain a label for UL508.
5. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).

C. Drive Enclosure Input Disconnect

1. Provide an enclosure door interlocked disconnect with motor circuit protector.

2. Operator Handles

a) Provide externally operated main disconnect handle.
b) Handles shall be lockable with up to three lockout / tagout padlock positions.

D. Branch Circuit Protection

1. Input motor circuit protector (MCP) shall be provided.

E. Bypass

1. SMC Flex / Pump Option Bypass (where shown on Drawings):

a) Shall provide a means to switch a single motor from drive control to bypass via a soft start (across the line operation).
b) Shall provide separate drive output and bypass contactors. The contactors shall be electrically and mechanically interlocked.
c) Shall provide a Drive/Off/Bypass selector switch, mounted on the enclosure door, for selection of Drive and Bypass modes of operation.
d) Provide a Class 20/30 overload for motor protection while operating in the bypass mode.
e) Shall provide smooth deceleration when stopping in bypass mode.
f) Shall provide a door-mounted HIM.
g) Shall provide bypass fusing on input of RVSS bypass unit.

F. Control Power Transformer

1. Provide a control power transformer mounted and wired inside of the drive system enclosure.
2. The transformer shall be rated for the VFD power requirements including a 300W motor heater.

G. Harmonic Mitigation Techniques

1. Drive Input Line Reactor

a) Provide a drive input line reactor mounted within the drive system enclosure for drives that are less than 100 horsepower.
b) The line reactor shall meet the following specifications:

i. The construction shall be iron core with an impedance of 3 percent.
ii. The winding shall be copper or aluminum wound.
iii. The insulation shall be Class H with a 115 °C rise over 50 °C ambient.
iv. The unit shall be rated for system voltage, ampacity, and frequency.

2. 18-pulse VFD (greater than 100 horsepower) with Auto Transformer

a) Provide VFD with a single 18-pulse converter.

i. The converter bridge shall be a parallel 18-pulse diode bridge assembly with DC snubber (board or assembly). Diodes shall be rated (devices) with a blocking voltage minimum of 1600V.
ii. The converter shall incorporate 1000V three phase block style MOV protection rated 85 °C.

b) The drive system shall incorporate an 18-pulse phase shifting auto transformer with line reactor as an assembly. The 18-pulse assembly shall be wired into the VFD System enclosure where possible. The auto transformer shall have the following minimum features:

i. Rated for input rectifier duty and matched to VFD overload capability.
ii. Copper or aluminum wound.
iii. Class 180 or 220 insulation.
iv. Power factor of 0.98 or better at rated load and nominal line voltage.
v. Open core construction.
vi. One normally closed thermal switch contact in each coil wired into a VFD control circuit.

c) The drive system shall be compliant with IEEE519-1992 standards at the input VFD terminals based upon the input power phase imbalance within 0.5% of nominal line voltage and under full VFD output current ratings.

H. Auxiliary Relays

1. Provide relays for Drive Alarm, Drive Fault, Drive Run, and System Status Faults (as required).

2. The relays shall be Allen-Bradley 700-HC or equal (2 N.O. & 2 N.C.). The relay contacts shall be rated for 115V AC/30V DC, 5.0 amp resistive, 2.5 amp inductive.

3. Disconnect contact for a 300W motor heater powered off control transformer within VFD bucket/enclosure.

I. Control Interface

1. The control terminals shall be rated for 115V AC.
2. The control interface shall provide input terminals for access to VFD functions that include start, stop, external fault, speed select, and enable, as required.

J. Hand/Off/Auto Selector Switch

1. Provide a "Hand/Off/Auto" selector switch, mounted on the enclosure door.
2. The "Hand/Off/Auto" selector switch shall start the drive in the “Hand” mode and stop the drive in the “Off” mode. All control is through the PLC which provides the enable and momentary start signal.
3. In the “Auto” mode the drive shall be started and stopped from a remote “RUN” contact.
4. In all modes, Auxiliary and Enable inputs to the drive control interface board must be present before the drive will start.

5. When a HIM is present, the stop function shall always be available to stop the drive regardless of the selected mode (“Hand” or “Auto”). The HIM will be non-functional (except for the display and programming) when the switch is in “Off” mode. The HIM shall stop the drive if the switch is in the “Auto” mode with the remote start contact initiated.
6. The drive speed reference shall be controlled from the HIM, unless a separate door- mounted potentiometer is provided, when in “Hand” mode (factory default setting).
7. The drive speed reference shall be controlled by a remote 4…20 mA input when in “Auto” mode.

8. The device shall be an Allen-Bradley Bulletin 800T (30mm) or equal, NEMA Type 4/13, mounted on the drive system enclosure door.

K. Drive Disable Mushroom Push Button

1. Provide a maintained mushroom style push button, mounted on the enclosure door that when pushed, will open the drive enable input.
2. The device shall be an Allen-Bradley Bulletin 800T (30mm) or equal, NEMA Type 4/13, mounted on the drive system enclosure door.

L. Pilot Lights

1. Provide LED pilot lights, mounted on the enclosure door, for indication of the following status:

a) Run
b) Drive Fault
c) Control Power On
d) Motor Fault

2. The device shall be an Allen-Bradley Bulletin 800T (30mm) or equal, NEMA Type 4/13, mounted on the drive system enclosure door.

M. Motor Run Time Meter

1. Provide a digital, non-resettable, door-mounted elapsed time meter.
2. The meter shall be electrically interlocked with the Drive Run relay and Bypass contactor to indicate actual motor operating hours.

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

CATSECTION 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 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. Manufacturer: Caterpillar per District's standards. No approved equal.

1. Contact Matthew Stephens, Quinn Power, (562) 463-6062.
2. Fuel tank and fueling system Contact John Scranton, Source N.A. Corp. (844) 818-0212.

C. General

1. Basis of design is CAT C32 with Level 2 Sound Housing.
2. Ratings based on site conditions of : Altitude 1900 ft. ambient temperatures up to 105ºF
3. The generator set rating shall be based on emergency/standby service.
4. The generator set shall operate at 1800 RPM and at a voltage of: 277/480Vac, 3 phase, Four-wire, 60 Hz.
5. The generator set shall be stand-by rated at 1,000kW, 1,250kVA, 1,503A at 0.8 PF.

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 an 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 125 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. Caterpillar EMCP4.3 minimum with Modbus IP

B. 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.

C. 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.

D. Communications shall be supported with building automation via the Modbus protocol without network cards. Optional internet and intranet connectivity shall be available.

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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.

L. 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 be rated 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 78dBA 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.

2.06 FUEL SYSTEM

A. General: Provide fuel system, accessories, and fuel tanks meeting the following requirements:

B. Main Fuel Tank: Provide an above ground fuel storage tank:

1. Standards: NFPA 30, Uniform Fire Code: UL 142 listed.
2. Capacity: 12,000 gallons
3. Primary Containment Tank: Welded steel tank; warranted for 30-year life.
4. Secondary Containment: Steel tank or membrane system with concrete or pearlite insulation; provide sufficient insulation for 2 hour fire rating.
5. Connections:
   a. Two-inch fill connection with spill sump and lockable fill cap.
   b. Two-inch fuel supply to engine with suction tube and foot valve.
   c. Two-inch fuel return line from engine.
   d. Two-inch fuel dispenser suction mount specified fuel dispenser.
   e. Primary tank level gauge connection with non-powered local level indicator.
   f. Primary tank level switch connection with capacitance type level probe and transmitter:
      1) Provide wire and conduit to connect 4-20mA control signal to main engine panel.
   g. Primary tank vent with vented cap routed 12 feet above grade.
   h. Primary tank emergency vent with vent weather cap.
   i. Secondary tank leak detection tubes with local leak indicator:
      1) Provide wire and conduit to connect to main engine panel.
6. Anchoring: Tank to have minimum 4 inches clear space under tank to allow for visible inspection for leaks. Seismic design to meet seismic requirements at the project site:
   a. Provide complete anchoring design sealed by a registered Professional Engineer in the State where the project is being constructed.
7. Labels: "Diesel Fuel" "No Smoking" labels and required hazardous substance labels as well as any additional labelling required by local fire department.

C. Day tank alarm/control panel with the following features as a minimum:

1. UL142 -listed located either between the skids or next to the generator.
2. Prewired and preconnected before delivery, including day tank.
3. Alarms and lights powered from engine/generator 12 or 24 volt DC batteries.
4. Push-to-test control switch and pump running indicator light, 1 for each pump.
5. Indicator or alarm lights for:
    a. Power available indication.
    b. Low level alarm.
    c. Low-low level alarm (engine shutdown).
    d. High level alarm.
    e. Critical high level alarm.
    f. Tank rupture alarm.
6. Relay contacts, rated 120 VAC 1.0 amp normally closed for the following:
    a. Low level.
    b. High level.
    c. Critical high level.
    d. Tank rupture.
    e. Low-low level wired to shutdown engine.
    f. Others as required.
7. Level indicator scaled in percent of full.
8. Fuel pump system:
    a. Components include, but are not limited to, the following:
        1) Fuel transfer pump:
            a) Minimum capacity of 10 percent above the total fuel flow required by the engine including fuel consumption and re-circulating flow from the engine at full load.
            b) Bronze gears and stainless steel shafts.
            c) Pump suction head to be adequate to draw fuel from the bottom of the storage tank.
        2) Motor: 460 volts AC, 3 phase, 60 Hertz, TEFC.
    b. Mount fuel transfer pump integral to the day tank skid.
    c. Control fuel transfer pump by internal float switches.
    d. Provide solenoid valve, normally closed, that opens when pump is operating.
    e. Provide a day tank mounted overflow-return pump with controller.

D. Aboveground Fuel Piping:

1. Supply and Return Piping: Provide Schedule 40 black steel supply and return piping from storage tank to generator as indicated on the Drawings.

2. Flexible Connections: Provide maximum 18-inch long flexible connections where off-skid connects to the engine skid are required.
3. Provide a check valve located on the tank side of the flexible connection in the return fuel line.
4. Provide a direct current solenoid shutoff valve, wire, conduit and control interlock to close on engine shutdown; locate on the tank side of the flexible connection in the fuel supply line.

2.07 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

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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 $\pm$ 1% of nominal voltage. Frequency sensing shall be accurate to $\pm$ 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.

2.05 POWER MANAGER

A. Furnish Power Managers to monitor all functions specified below for all ATS/BPS.

B. The Power Managers shall be listed to UL 3111-1, CSA, CE Mark, and industrially rated for an operating temperature range of -20 C to 60 C.

C. The Power Manager shall be accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).

D. The Power Manager shall be capable of operating without modification at nominal frequencies of 45 to 66 Hz and over a control power input range of 20 - 32VDC.

E. Each Power Manager shall be capable of interfacing with an optional communications module to permit information to be sent to central location for display, analysis, and logging.

F. The Power Manager shall accept inputs from industry standard instrument transformers (120 VAC secondary PTs and 5A secondary CTs.) Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PTs.

G. The Power Manager shall be applied in single, 3-phase, or three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.

H. All setup parameters required by the Power Manager shall be stored in non-volatile memory and retained in the event of a control power interruption.

I. The following metered readings shall be communicated by the Power Manager, via serial communication, when equipped with optional serial communications module:

1. Current, per phase RMS and neutral (if applicable)
2. Current Unbalance %
3. Voltage, phase-to-phase and phase-to-neutral
4. Voltage Unbalance %
5. Real power (KW), per phase and 3-phase total
6. Apparent power (KVA), per phase and 3-phase total
7. Reactive power (KVAR), per phase and 3-phase total
8. Power factor, 3-phase total & per phase
9. Frequency
10. Accumulated Energy, (MWH, MVAH, and MVARH)

J. The following energy readings shall be communicated by the Power Manager:

1. Accumulated real energy KWH
2. Accumulated reactive energy KVAH
3. Accumulated apparent energy KVARH

K. Power Manager Input/Output Options.

1. Power Managers shall be equipped with the following I/O:
   a. Provide (8) solid state status inputs.
   b. Provide four (4) relay output contacts

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 inidicated 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 43 13

TRANSIENT VOLTAGE SURGE SUPPRESSORS

THE DISTRICT WILL BE PROVIDING THIS EQUIPMENT UNDER A SEPARATE CONTRACT. THE BIDDING CONTRACTOR WILL BE RESPONSIBLE FOR TRANSPORTING FROM CORP YARD AND INSTALLATION PER PART 3.

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 transient voltage surge suppressors (TVSS).

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. C62.11; Metal-Oxide Surge Arresters for Alternating Current Power Circuits
    b. C62.33; Standard Test Specifications for Varistor Surge-Protective Devices
    c. C62.41; Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
    d. C62.45; Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
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. IEEE –Institute of Electrical and Electronic Engineers
    a. 446; Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

b. 1100; Recommended Practices Powering and Grounding Electronic Equipment

4. Military Specification
   a. MIL-STD-220; Test Method Standard, Method of Insertion Loss Measurement
5. NEMA –National Electrical Manufacturer's Association
   a. LS1; Low Voltage Surge Protection Devices
6. UL -Underwriters Laboratories, Inc.
   a. 50; Standard for Enclosures for Electrical Equipment
   b. 67; Standard for Panelboards
   c. 845; Standard for Motor Control Centers
   d. 857; Busways
   e. 1283; Standard for Electromagnetic Interference Filters
   f. 1449; Standard for Transient Voltage Surge Suppressors

1.03 SYSTEM DESCRIPTION

A. The TVSS shall be a parallel design transient voltage surge suppression system integrated into panelboards and distribution panels. The system shall utilize diversion modules to suppress and divert transient voltage and surge currents. The system shall be design to provide protection for sensitive electronic devices against the effects of surges, transients and electrical line noises.

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.

1.06 DELIVERY, STORAGE AND HANDLING

A. Handle carefully to avoid damage to internal components, enclosure and finish.

PART 2 -PRODUCTS

2.01 MANUFACTURER

A. APT, Current Technology, Cutler-Hammer or approved equal.

2.02 GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 2nd Edition Suppressed Voltage Rating (SVR) – The maximum UL 1449 2nd Edition SVR for the device must not exceed the following:
    a. Voltage: L-N; L-G; N-G & L-L modes
    b. 208Y/120: 400V & 800V
    c. 480Y/277: 800V & 1800V
    d. 600Y/347: 1200V & 1800V
6. – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:
    a. Voltage: L-N
    b. 208Y/120: 560V
    c. 480Y/277: 960V
    d. 600Y/347: 1840V
7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:
    a. Voltage: L-N
    b. 208Y/120: 160V
    c. 480Y/277: 165V
    d. 600Y/347: 168V

B. TVSS Design

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating TVSS modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.

3. Extended Range Filter –The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies.
    a. Attenuation Frequency - Insertion Loss (ratio) - Insertion Loss (dB)
    b. 50kHz -40 -32
    c. 100kHz -316 -50
    d. 500kHz -318 -50
    e. 1MHz -89 -39
    f. 10MHz -200 -46
    g. 100MHz -79 -38
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:
    a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light, shall indicate which phase(s) have been damaged.
    b. Remote Status Monitor – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
    c. Audible Alarm – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
    d. Event Counter – The TVSS shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event-counter triggers each time under each respective category after significant event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
    e. Push to Test – The TVSS shall be equipped with push-to-test feature, designed to provide users with real time testing of the suppressor’s monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.
    f. Voltage Monitoring – The TVSS shall display true Root Mean Square (RMS) on three L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.
6. Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition , the manufacturer shall provide:
    a. Individual Fusing: MOV’s shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events.
    b. Thermal Protection: MOV’s shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component

at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A.

c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.

C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992

1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50µsec, 20kV open circuit voltage. 8 x 20µsec, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:

a. Service Entrance: 12000 impulse per mode.

b. Distribution Panelboard: 10000 impulse per mode.

c. Branch Location Panelboard: 9000 impulse per mode.

2.03 SYSTEM APPLICATION

A. The TVSS applications covered under this section include distribution and branch panel locations, bus plugs, motor control centers (MCC), switchgear, and switchboard assemblies. The branch panel located TVSS shall be tested and demonstrate to be suitable for ANSI/IEEE C62.41 Category C1 environments.

1. Surge Current Capacity - The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding in compliance to ANSI/IEEE C62.41 AND NEMA LS1

a. Application -Service Entrance Locations (Switchboards Switchgear, MCC Main Entrance)

1) 250kA Per Phase

2) 125kA Per Mode

3) 12,000 Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)

2. Application -High Exposure Roof Top Locations (Distribution Panelboards)

1) 160kA Per Phase

2) 80kA Per Mode

3) 9,000 Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)

3. Application -Branch Locations (Panelboards, MCCs, Busway)

1) 120kA Per Phase

2) 60kA Per Mode

3) 5,000 Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)

B. Lighting and Distribution Panelboard Requirements

1. The TVSS application covered under this section includes lighting and distribution panelboards. The TVSS units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.
2. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
3. The TVSS shall be immediately installed on the load side of the main breaker.
4. The panelboard shall be capable of re-energizing upon removal of the TVSS.
5. A direct bus bar connection shall be used to mount the TVSS component to the panelboard bus bar to reduce the impedance of the shunt path.
6. The TVSS panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and TVSS device is not acceptable). TVSS units that use a cable connection do not meet the intent of this specification.
7. The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.
8. The complete panelboard including the TVSS shall be UL67 listed.

C. Retrofit Installation (externally mounted suppressor). Maximum conductor lead length between breaker and suppressor shall not exceed 14 inches. Comply with the manufacturer's recommended installation and wiring practices.

D. Switchgear, Switchboard, MCC and Busway/ Bus Plug Requirements

1. The TVSS application covered under this section is for switchgear, switchboard, MCC and Bus Plug locations. Service entrance located TVSS shall be tested and suitable for ANSI/IEEE C62.41 Category C3 environments.
2. The TVSS shall be factory installed inside the switchgear, switchboard, MCC and Bus Plug at the assembly point by the original equipment manufacturer.
3. Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.
4. Provide a 30-amp disconnect. The disconnect shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.
5. The TVSS shall be integral to switchgear, switchboard, MCC and Bus Plug as factory standardized design.
6. All monitoring diagnostics features shall be visible from the front of the equipment.

2.04 ENCLOSURES

A. All enclosed equipment shall have NEMA 1/3R general purpose enclosures, unless otherwise noted.

PART 3 -EXECUTION

3.01 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

B. Provide TVSS protection for electrical equipment where indicated on Drawings.

C. External and Retrofit TVSS Applications

1. Conductors from the power source to TVSS shall be #4 AWG copper with absolute maximum length of 84” in Service Entrance Locations (Switchboards, Switchgear, MCC Main Entrance) & #8 AWG copper with absolute maximum length of 12” in all other applications.

2. Conductors shall be routed without sharp bends and straight and short as possible.

3. External cabinets shall be anchored and braced to withstand seismic forces.

3.02 FIELD QUALITY CONTROL

A. Prior to energizing TVSS inspect for physical damage, defects, alignment and fit; verify nameplate information with application and Drawings; and check tightness of all control and power connections.

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 05 28

PATHWAYS FOR COMMUNICATION 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 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 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
    a. 27 05 26 – Grounding and Bonding for Electrical Systems
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. 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); ICBO Uniform Building Code (UBC) 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/NEC 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 Architect or 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 Architectural Drawings, and where heights are not suited for construction or finish please consult Engineer or Architect.
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/NEC.
    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 27 15 23

FIBER OPTIC 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 fiber optic based data communication cabling systems which include:

   a. Provide all necessary cabling and termination equipment for a complete cabling system.

   b. Terminate, test and document fiber optic cabling 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.

   a. 27 05 28 – Pathways for Communication System

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. INCITS 263; Fiber Distributed Data Interface (FDDI) - Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)

   b. 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. Fiber Optic Standards
      1) TIA/EIA-455 Series; Fiber Optic Test Procedures including TIA/EIA-455-B; Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components, and All latest FOTPs related to fiber optic cables, connectors and passive devices.
      2) TIA/EIA-4920000-B; Generic Specification for Optical Waveguide Fibers
      3) TIA/EIA-492A000-A; Sectional Specification for Class Ia Multimode, Graded-Index Optical Waveguide Fibers
      4) TIA/EIA-492AAAA-A; Detail Specification for 62.5µm Core Diameter/125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers
      5) TIA/EIA-492AAAB; Detail Specification for 50µm Core Diameter/125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers
      6) TIA/EIA-598-A; Optical Fiber Cable Color Coding
      7) TIA/EIA-604; Fiber Optic Connector Intermateability Standards
      8) TIA/EIA-4720000-A; Generic Specification for Fiber Optic Cable
      9) TIA/EIA-472C000-A; Sectional Specification for Fiber Optic Communications Cable for Indoor Use
      10) TIA/EIA-472D000-A; Sectional Specification for Fiber Optic Communications Cable for Outside Plant Use
      11) TIA/EIA-4750000-C; Generic Specification for Fiber Optic Connectors
      12) TIA-5150000; Generic Specification for Optical Fiber and Cable Splices
      13) TIA-515B000; Sectional Specification for Splice Closures for Pressurized Aerial, Buried, and Underground Fiber Optic Cables
      14) TIA-6090000; Generic Specification for Optical Fiber Splice
      15) TIA-609A000; Sectional Specification for Conventional, Permanent, Optical Fiber Splice
      16) TSB62; Informative Test Methods (ITMs) for Fiber-Optic Fibers, Cables, Opto-Electronic Sources and Detectors, Sensors, Connecting and Terminating Devices, and Other Fiber-Optic Components
   b. Wiring/Cabling Standards
      1) TIA/EIA-568-B.1; Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
      2) TIA/EIA-568-B.3; Optical Fiber Cabling Components Standard
      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. ICEA –Insulated Cable Engineers Association
    a. S-83-596; Fiber Optic Premises Distribution Cable
    b. S-87-640; Fiber Optic Outside Plant Communications Cable
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
7. NECA –National Electrical Contractors Association
    a. NECA/BICSI 568; Standard for Installing Commercial Building Telecommunications Systems
8. Telcordia Documents
    a. GR-20; Generic Requirements for Optical Fiber and Optical Fiber Cable
    b. GR-409; Generic Requirements for Premises Fiber Optic Cable
    c. GR-1435; Generic Requirements for Multi-Fiber Optical Connectors
    d. GR-2961; Generic Requirements for Multi-Purpose Fiber Optic Cable
9. UL –Underwriters Laboratories, Inc.
    a. 444; Communications Cables
    b. 1651; Standard for Optical Fiber Cable
    c. 1666; Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
    d. 1685; Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
10. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA) Standards
    a. PE-90; Totally Filled Fiber Optic Cable
    b. TE&CM Section 644; Design and Construction of Underground Cable

1.03 SYSTEM PERFORMANCE STANRDARDS

A. Fiber optic cabling:
    1. To applicable EIA/TIA standards using a digital cable analyzer and/or OTDR 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. Optical power meter and/or optical time domain reflectometer (OTDR) tester with applicable fiber testing standards required within this Section.

c. 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.

PART 2 -PRODUCTS

2.01 FIBER OPTIC COMMUNICATIONS CABLES

A. General Requirements

1. Cabling construction and use shall comply with CEC/NEC Article 770.

2. Fiber count per cable to comply with minimum counts indicated on the Drawings.

3. All fiber optics shall comply with all applicable EIA and Telcordia standards including but not limited to EIA-455, EIA-492, EIA-598, GR-20 and GR-409.
4. All fibers shall be of grade index type.
5. Each fiber to be attenuation tested by the Manufacturer prior to shipping to indicate conformance of shipped cable to requirements herein. Manufacturer's test to be affixed to shipping reel.
6. Maximum required bend radius at installation and long term application should not exceed manufacturer's recommended values.
7. Minimum safe longitudinal load at installation and long term application should not exceed manufacturer's recommended values.
8. Construction
    a. All diaelectric central and strengthen materials.
    b. Fiberglass epoxy rod/Kevlar strengthening member(s).
    c. Fiber coating to be mechanically strippable, dual layered, UV-cured acrylate applied by the fiber manufacturer.
    d. Outer jacket shall be polyethylene, polyurethane or polyvinylchloride with 0.040" minimum thickness as required by application, listings and CEC/NEC requirements.
    e. Tight Buffer Design
        1) Water blocking attributes per EIA-455.
        2) Optical fiber surrounding by 250µm primary polymer buffer and 900µm strippable PVC secondary buffer.
        3) Individual sub cables supported by being molded into the cable's overall protective jacket ("core locking" design), extruded onto the stranded cable core.
        4) Strippable and sliceable directly to loose tube construction 250µm primary coating cable with no interface loss or optical return in excess of standards specified elsewhere herein.
        5) Aramid yarn filler, precisely uniformly tensioned around fiber.
    f. Loose Tube, Gel Filled Design
        1) Multiple fiber strands per tube which is kink resistant within specified bend radius.
        2) Inorganic, non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel which is readily removable with non-toxic solvents.
        3) Inorganic, non-hygroscopic binder fill provided to supplement and support uniform cable construction as required.
        4) Buffer tubes stranded around central support member using "S-Z" process, left hand lay.
        5) Binders to be applied with sufficient tension to secure buffer tubes to the central member without crushing buffer tube(s).

6) High tensile strength dielectric yarns helically woven around cable core to provide tensile strength.

7) Zero flow of filling/gel per FOTP-81.

9. Multi-mode Fiber, General Specifications

a. All multi-mode fiber installed shall be 50/125µm unless otherwise requested by Owner.

b. Performance and Optical

1) Application Support Distances Minimums

a) 10Mb/s Ethernet at 850nm/1300nm: 1250m/1250m

b) 100Mb/s Ethernet at 850nm/1300nm: 300m/2000m

c) 1Gb/s Ethernet at 850nm/1300nm: 500m/1000m

d) 10Gb/s Ethernet at 850nm/1300nm: 300m/300m

2) Attenuation

a) 850nm wavelength: ≤ 3.0dB/km

b) 1300nm wavelength: ≤ 1.0dB/km

c) No point discontinuity > 0.2dB.

d) Attenuation at 1380nm does not exceed attenuation at 1300nm by more than 3.0dB/km.

e) Induced attenuation from 100 turns around a 75mm mandrel shall be ≤ 0.5dB at 850nm and 1300 nm.

3) Chromatic Dispersion

a) Minimum Zero Dispersion Wavelength: 1300nm

b) Maximum Zero Dispersion Wavelength: 1320nm

c) Zero Dispersion Slope: ≤ 0.101ps/nm^2-km

4) Effective Modal Bandwidth Minimums

a) Laser based systems (≤ 1Gb/s) per EIA-455-204 at 850nm: 510MHz-km

b) Legacy and LED based systems (≤ 100Mb/s) per EIA-492:

1) at 850nm: 500MHz-km

2) at 1300nm: 500MHz-km

5) Numerical Aperture: 0.200 ± 0.0015

c. Environmental

1) Temperature induced attenuation at 850nm and 1300nm from -60°C to 85°C: ≤ 0.20dB/km

2) Humidity induced attenuation at 850nm and 1300nm from -10°C to 85°C and 4% to 98% relative humidity: ≤ 0.20dB/km

3) Fatigue Resistance Parameter (N_p): ≥ 18

d. Construction

1) Cladding Diameter: 125 ± 2.0µm
2) Coating/Cladding Offset: < 12µm
3) Coating Diameter: 245 ± 5µm
4) Core/Cladding Offset: ≤ 1.5µm
5) Core Diameter: 50 ± 3.0µm
6) Non-Circularity Core: ≤ 5%
7) Non-Circularity Cladding: ≤ 1.0%
8) Tensile Proof Test: 100kpsi (0.7GPa)

10. Single-mode Fiber, General Specifications

a. Performance and Optical

1) Maximum Attenuation
   a) 1310nm Wavelength: 0.40dB/km
   b) 1550nm Wavelength: 0.30dB/km
2) Chromatic Dispersion
   a) Zero Dispersion Wavelength: 1317nm
   b) Zero Dispersion Slope: ≤ 0.088 ps/nm^2-km
3) Mode-Field Diameter
   a) 1310nm Wavelength: 9.4 ± 0.4µm
   b) 1550nm Wavelength: 10.6 ± 0.5µm
4) Numerical Aperture: 0.14
5) Point discontinuity at 1310nm and 1550nm ≤ 0.05dB.

b. Environmental

1) Temperature induced attenuation at 1310nm, 1550nm and 1625nm from -60°C to 85°C: ≤ 0.05dB/km
2) Humidity induced attenuation at 1310nm, 1550nm and 1625nm from -10°C to 85°C and 4% to 98% relative humidity: ≤ 0.05dB/km
3) Fatigue Resistance Parameter (N_p): ≥ 18

c. Construction

1) Cladding Diameter: 125 ± 0.7µm
2) Coating/Cladding Offset: < 12µm
3) Coating Diameter: 245 ± 5µm
4) Core/Cladding Offset: ≤ 0.5µm
5) Core Diameter: 8.2µm

6) Fiber Curl: ≥ 4.0m radius of curvature
7) Non-Circularity Cladding: ≤ 0.7%
8) Tensile Proof Test: 100kpsi (0.7GPa)

B. Indoor, Inside Distribution/Breakout Cable, (Type OFNP)
1. Drawing Reference
a. Multi-mode: ## FOM-IDW, where ## indicates fiber count
b. Single-mode: ## FOS-IDW, where ## indicates fiber count
2. Construction
a. Multi-mode or single-mode fibers as indicated in Drawings per General Requirements listed above.
b. Breakout style construction per General Requirements listed above with rip cord for outer sheath removal.
c. Suitable and approved for indoor use within plenum spaces.
3. Manufacturer
a. Multi-mode: Mohawk RiserLite with AdvanceLite Grade 4, Superior Essex TeraGain or approved equal.
b. Single-mode: Mohawk RiserLite with AdvanceLite Grade SM1, Superior Essex Singlemode or approved equal.

C. Indoor, Riser (Type OFNR/OFNP)
1. Drawing Reference
a. Multi-mode: ## FOM-R, where ## indicates fiber count
b. Single-mode: ## FOS-R, where ## indicates fiber count
2. Construction
a. Multi-mode or single-mode fibers as indicated in Drawings per General Requirements listed above.
b. Tight buffered, core lock construction per General Requirements listed above.
c. Suitable and approved for indoor use within vertical shafts spaces.
3. Manufacturer
a. Multi-mode: Mohawk RiserLite with AdvanceLite Grade 4, Superior Essex TeraGain or approved equal.
b. Single-mode: Mohawk RiserLite with AdvanceLite Grade SM1, Superior Essex Singlemode or approved equal.

D. Outdoor, underground (Type OFNR)
1. Drawing Reference
a. Multi-mode: ## FOM-OSP, where ## indicates fiber count
b. Single-mode: ## FOS-OSP, where ## indicates fiber count
2. Construction

a. Multi-mode or single-mode fibers as indicated in Drawings per General Requirements listed above.

b. Tight buffered or loose tube, gel filled design per General Requirements listed above.

c. Zero water entry per FOTP-82, 24 hours immersion.

d. Flooding compound and general cable construction shall be listed, suitable for underground and wet applications.

3. Manufacturer

a. Multi-mode: Mohawk RiserLite with AdvanceLite Grade 4, Superior Essex TeraGain or approved equal.

b. Single-mode: Mohawk RiserLite with AdvanceLite Grade SM1, Superior Essex Singlemode or approved equal.

2.02 FIBER CABLE TERMINATION DEVICES AND RELATED

A. Connectors

1. Types

a. Multi-mode: SC type unless otherwise noted, shown or required.

b. Single-mode: LC type unless otherwise noted, shown or required.

2. Zirconia ceramic ferrule type to suit application.

3. Performance

a. Insertion Loss

1) Multi-mode: ≤ 0.20 dB, typical

2) Single-mode: ≤ 0.20 dB, typical

b. Return Loss

1) Multi-mode: ≤ -30 dB, typical

2) Single-mode: ≤ -55 dB, typical

4. Manufacturers

a. Siemons, 3M or approved equal.

B. Break-out and Fan-out Kits

1. Kits separate six or twelve 250 µm fibers and route them into color-coded 900 µm buffer tubes.

2. Manufacturers

a. Leviton, Corning Cable Systems or approved equal.

C. Splices

1. Mechanical Splices

a. Permanent application, integral matching index gel.

b. Self-centering fiber alignment mechanism.

c. Performance

1) Insertion loss, typical:

a) Multi-mode: ≤ 0.30 dB

b) Single-mode: ≤ 0.15 dB

2) Manufacturer's guaranteed rating worst insertion loss for splice ≤ 0.5 dB.

3) Return Loss

a) Flat cleave: ≤ -45 dB

b) Angled cleave: ≤ -60 dB

4) Minimum fiber strain relief: 0.75 lbs

d. Manufacturers

1) Corning Optical System Camsplice, 3M Fibrlok or approved equal.

2. Fusion Splices

a. Computerized optical aligner and tester with integral fuser.

b. Splice protected with a heat shrink cover.

c. Insertion loss, typical:

1) Multi-mode: ≤ 0.30 dB, typical

2) Single-mode: ≤ 0.20 dB, typical

3) Manufacturer's guaranteed rating worst case for multi-mode or single-mode splice is ≤ 0.5 dB.

d. Manufacturers

1) Corner Cable System or equal.

2.03 FIBER OPTIC TERMINATION EQUIPMENT AND RELATED

A. Fiber Terminal Cabinet, Wall Mount, Patch Panel/Splice Tray

1. Drawing Reference:

a. ##FTB: Fiber Terminal Box – Patch and cable storage only, where ## refers to fiber port count.

b. ##FSB: Fiber Splice Box – Splice only, where ## refers to fiber strand count.

2. Fiber Optic Terminal Cabinet

a. Provides a location for patching portable and rack mounted equipment to permanently installed fiber infrastructure.

b. Constructed of 0.125 inch minimum thick aluminum or powder coated steel with hinged, lockable door.

c. Holds a minimum of 4 fiber adapter plates that can each accommodate 6 to 12 single SC, ST or LC termination ports. Install blank adapters as required to fill spaces.

d. Two compartment

1) Interior fiber coil rings/splice compartment.
2) Connector interface compartment.

3. Manufacturers
   a. Leviton 5Wx30, Siemon SWIC3G or approved equal.

B. Fiber Distribution Panels, Splice and Patch
1. Drawing References:
   a. ##FDP – Splice and Patch Panel, where ## refers to fiber port count.
   b. ##FPP – Patch Panel Only, where ## refers to fiber port count.
   c. ##FSP – Splice only, where ## refers to fiber port count.
2. Features/Functions/Performance
   a. Provides a location for splice, maintenance and cross-connecting of fiber optic cables.
   b. 19” EIA rack mount with polycarbonate locking door suitable for housing fiber optic splices in a neat and orderly fashion and/or contain a patch panel front.
   c. Incorporates cable tie downs and routing rings, and should store a minimum of one meter of cable without kinks or twists.
   d. Suitable for re-entry, if required for future maintenance or modification without damage to the cable or splices.
   e. All required splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors shall be provided in the organizer kit.
   f. Holds fiber adapter plates that can each accommodate SC, ST or LC termination ports. Install blank adapters as required to fill spaces. The minimum number of fiber terminations per rack unit is as follows:
      1) 1 rack unit = 16 fibers
      2) 2 rack units = 48 fibers
      3) 3 rack units = 96 fibers
      4) 4 rack units = 144 fibers
      5) 6 rack units = 192 fibers
3. Manufacturers
   a. Leviton 5Rx60 series, Siemon RIC3 series or approved equal.

C. Fiber Splice Closure
1. Drawing Reference: FSC
2. Functions/Features
   a. Where indicated on plans, provides re-enterable underground splice closure.
   b. Plastic construction – no corrodible materials.
   c. Waterproof, suitable for direct burial
   d. Fusion splice protection chamber

e. Grommet cable entrance and exits.

3. Manufacturers

a. Corning Cable Systems SCF, 3M Fiber Optic Closure System LL 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. 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 770.

B. Fiber Installation:

1. All fiber optic 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. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

4. 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.

5. Do not subject 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.

6. Provide a box loop for all 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.

7. Secure all cable run vertically for continuous distances greater than thirty (30) feet with symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

8. Where drawings specifically permit use of exposed cable installation in Plenum and/or Suspended Ceiling voids, conform to the following:

a. 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.

b. Placement: Do not obscure access to access doors, hatches, air dampers, valves, cable trays, junction boxes, pull boxes or similar areas of access.

c. Place EMT pipe sleeves at all wall penetrations. Fire stop sleeves and cables where penetrating a rated wall with an approved UL assembly.

9. 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 fiber size and type. Comply with manufacturer’s recommendations, and make connections with automatic impact type tooling set to a recommended force.

d. 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.

e. 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) Ungrommeted, unbushed, or uninsulated wire or cable entries.

6) Deformation or improper radius of wire or cable.

f. Limit cable bends to a minimum radius of eight (8) times cable diameter except where otherwise noted herein.

g. 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.

h. 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. 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.

i. Tie wraps to be hand (not tool) tightened.

10. 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 heat shrink.

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.

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. Fiber Optic Cabling

1. Perform fiber optic cable testing on all installed fiber optic cabling. Notify Owner or Engineer in writing at least 48 hours in advance that fiber optic cable testing shall commence. Submit test results and calibration certification for testing equipment to be used.
2. Submit test report no later than five days after the cables are tested.
3. Attenuation Assessments
    a. Submit power meter attenuation assessments test results on each fiber strand, in each cable, and in both directions under final installation conditions. Submit with the following information:
        1) Date of test
        2) Name of test personnel
        3) Fiber cable type and part number
        4) Fiber number
        5) TX wavelength
        6) TX location
        7) RX location
        8) TX model and serial number
        9) RX model and serial number
        10) Attenuation in dB

4. OTDR Distance and Attenuation Assessments (Contractor to provide only as required for troubleshooting or locating faults on the fiber).
    a. Test and submit strip charts and/or tracer recordings on all strands in each cable in both directions. Submit with the following information:
        1) Date of test
        2) Name of test personnel
        3) Test wavelength
        4) Pulse duration(s) and scale range(s)
        5) Index of refraction
        6) Fiber cable type and part number
        7) Fiber tube and/or fiber strand number
        8) Direction of test
        9) Overall distance
        10) Attenuation in dB
5. Acceptance Tests
    a. Power Meter Attenuation Test
        1) Perform the following measurement attenuation tests using the insertion method. Measure the attenuation of the fiber optic network inclusive of all splices and patch points called for on the Drawings.
        2) Measure attenuation between all the couplings using the insertion method.
            1) Perform a reference measurement in dBm to determine the injection power level of the stabilized source. Reference cable shall have the same core diameter as strands under test. Connect the optical source directly to the optical power level meter using 2 reference cables and a coupler.
            2) Connect the optical source to the strand under test using 1 of the 2 reference cables attached to the strand's terminal coupler.
            3) Connect the optical power level meter to the other end of the strand under test through its terminating coupler using the other reference cable.
            4) Obtain the measured attenuation (in dB) by subtracting the reference level (dBm) from the received level (dBm).
            5) Periodically during the acceptance tests, check and document the reference level.
        3) Test each fiber link for overall attenuation from end to end in both directions.
    b. Perform the attenuation acceptance test at the 850nm wavelength for multi-mode and 1310nm for single-mode

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 tank foundation, electrical pads, 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 crushed rock; equipment pads designated to be demolished; 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 31 23 17 – Trenching, Backfilling and Compaction

C. Section 31 23 19 – Structure Excavation and Backfilling

D. Section 01 57 23 – Storm Water Pollution Prevention Plan

E. Section 01 57 27 – Dust Control

1.3 REFERENCES

A. Section 19 – Earthwork, State Standard Specifications

1.4 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 materials are gathered for analysis or testing.

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. Two tests 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

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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 19 – Structure Excavation and Backfilling

1.3 REFERENCES

A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft^3 (600 kN m/m^3))

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 D75 Standard Practice for Sampling Aggregates

F. ASTM D6938 – Density of soil and base rock in place by Nuclear method.

G. ASTM D2937 – Density of soil and in place by Tube method.

H. Section 26 – Aggregate Bases, State Standard Specifications.

I. Section 15 – Existing Facilities, State Standard Specifications

J. Section 18 – Dust Palliatives, State Standard Specifications

K. Section 19 – Earthwork, State Standard Specifications

L. *Geotechnical Engineering Investigation* entitled, Geotechnical Engineering Investigation Report, Camrosa WD GAC Treatment, Thousand Oaks, California by BSK Associates, dated April 28, 2021.

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. 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 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:

1. All compaction testing shall be in accordance with Section 01 43 00 - Quality Control and 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 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.

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 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 TRENCH EXCAVATION AND BACKFILLING

A. Refer to Section 31 23 17 – Trenching, Backfilling, and Compacting.

3.7 UTILITY INSTALLATION

A. 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.

3.8 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.

3.9 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.

3.10 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.

3.11 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.

3.12 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 canal and roads from those specified	±0.10 foot
Variation from specified width of section at any height	±0.25 foot
Departure from established alignment on tangents along the canal	0.30 foot
Departure from established alignment on curves along the canal	0.50 foot

C. Variation is defined as the distance between the actual dimension and grade of the canal cross section or alignment and the specified position in plan for the canal cross section or 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

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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 D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft3 (600 kN m/m3))

C. 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.

D. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

E. ASTM D6938 – 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 19 – Earthwork, State Standard Specifications.

H. Section 26 – Aggregate Bases, State Standard Specifications.

I. *Geotechnical Engineering Investigation* entitled*,* Geotechnical Engineering Investigation Report, Camrosa WD GAC Treatment, Thousand Oaks, California by BSK Associates, dated April 28, 2021.

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 QUALITY ASSURANCE

A. Compaction Testing:

1. All compaction testing shall be in accordance with Section 01 43 00 - Quality Control and Testing.

1.7 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.

1.8 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. 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 90-1.02C(4), 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 19-3.02F(2), State Standard Specifications.

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 01 – 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. 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 600 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 400 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 & Compaction

C. Section 01 57 23 – Storm Water Pollution Prevention Plan

D. Section 01 57 27 – Dust Control

E. Section 03 30 01 – Cast in Place Concrete

1.3 REFERENCES

A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft^3 (600 kN m/m^3))

C. 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)

D. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

E. ASTM D6938 – 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 25 – Aggregate Subbases, State Standard Specifications

H. Section 26 – Aggregate Bases, State Standard Specifications

I. *Geotechnical Engineering Investigation* entitled, Geotechnical Engineering Investigation Report, Camrosa WD GAC Treatment, Thousand Oaks, California by BSK Associates, dated April 28, 2021.

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 samples under provisions of Section 01 43 00 – Quality Control and Testing.

B. Submit 10 lb sample of each type of fill to testing laboratory, in airtight containers.

1.6 QUALITY ASSURANCE

A. Compaction Testing

All compaction testing shall be in accordance with Section 01 43 00, Quality Control and 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. Two tests every 10,000 square feet of engineered fill or aggregate base material placed.

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 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 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.

2.4 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.

2.5 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 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.

3.5 TOLERANCES

A. Top Surface of Backfilling: ±0.1 foot from design grade.

3.6 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 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 30 01 – Cast-In-Place Concrete

D. Section 31 11 00 – Clearing and Grubbing

1.3 REFERENCES

A. ASTM D75 – Practice for Sampling Aggregates.

B. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

C. ANSI/ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lb/ft^3 (600 kN m/m^3))

D. 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.

E. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.

F. ASTM D2922 and D3017 – Density of soil and base rock in place by Nuclear method.

G. ASTM D2937 – Density of soil and in place by Tube method.

H. Section 26 – Aggregate Bases, State Standard Specifications.

I. Section 16 – Clearing and Grubbing, State Standard Specifications

J. Section 17 – Watering, State Standard Specifications

K. Section 19 – Earthwork, State Standard Specifications

L. Geotechnical Engineering Investigation entitled, Geotechnical Engineering Investigation Report, Camrosa WD GAC Treatment, Thousand Oaks, California by BSK Associates, dated April 28, 2021.

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 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. Submittals shall be in accordance with the Standard General Conditions and the Supplementary Conditions.

C. If materials are obtained from a commercial source, submit certification from the supplier certifying that aggregate base course meets the requirements of this section.

D. 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. RECYCLED AGGREGATE BASE COURSE

1. Recycled aggregate base course material must meet the requirements of State Standard Specifications, Section 26—1.02B, for Class 2, ¾-inch maximum. This material shall not contain any metal rebar. Testing required to determine compliance of material shall be at the expense of the Contractor.

2. Recycled aggregate base may be made from Portland cement concrete or asphalt concrete, or a mix of the two.

3. No organic or other deleterious materials may be present in the material.

C. 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.

D. WATER

1. As specified in Section 01 51 36, Watering.

2. 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 and 01 51 36, Watering.

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 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/driveway. 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 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 –Submittal Procedures.

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 selected and paid for by the Owner. The independent testing laboratory shall be used to sample and test asphalt concrete at the job site. 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 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.

PART 2 PRODUCTS

2.1 ASPHALTS

A. Asphalt binder to be mixed with aggregate shall be liquid asphalt PG 64-10, 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 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 39-2.05A(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 MISCELLANEOUS AREAS

A. Paving miscellaneous areas shall conform to State Standard Specifications Section 39-2.01C(9), Miscellaneous Areas and Dikes.

3.10 FINISHING PAVED AREAS

A. Finishing roadway and parking areas shall conform to the provisions of State Standard Specifications Section 22, Finishing Roadways.

3.11 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.

3.12 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 31 00

FENCING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials and equipment and perform all operations necessary to complete and install chain link fencing, fence enclosure and gates as specified, shown on the Drawings, or as directed.

B. Furnish and Install fencing as shown on the Plans.

C. Re-use of existing fence materials will not be accepted.

1.2 RELATED WORK

A. Section 03 30 01 – Cast-in-Place Concrete

B. Section 05 50 00 – Fabricated Metal

C. Section 31 23 00 – Earthwork

1.3 REFERENCES

A. Section 80 – Fences, State Standard Specifications

1.4 SUBMITTALS

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

PART 2 PRODUCTS

A. Chain Link and barbed wire shall conform to State Standard Specifications Section 80-3.02 and the details shown on the plans. Where the requirements differ, the more restrictive (i.e. largest member) requirement shall prevail.

B. All fence lines and gates shall be furnished with ultraviolet resistant HDPE privacy slats conforming with State Standard Specifications Section 80-3.02E. Color to be selected by the Owner.

C. Right of Way fence shall conform to State Standard Specifications Section 80-3.

PART 3 EXECUTION

3.1 FENCES AND GATES

A. Installation shall be in accordance with State Standard Specifications, Section 80, and with State Standard Plans Drawing A85, A85A and as indicated on the Plans.

3.2 GATES

A. Gates shall conform with the requirements of State Standard Specifications Section 80-10, Gates.

B. Existing gates shall be replaced as shown on the Plans.

END SECTION

SECTION 33 13 00

DISINFECTION OF WATER SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

A. Disinfection of all potable water piping, treated water storage tank, GAC treatment system, pumps components, and appurtenances.

B. 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.

C. Before allowing water from the municipal supply system to enter the new potable water system, all its components shall be cleaned and disinfected.

D. Test and report results. Cost of all testing shall be borne by the Contractor.

E. Connect new system and existing water distribution mains, after all required tests are satisfactory and approved by the Engineer.

1.2 RELATED WORK

A. Section 01 11 10 – Coordination of Work (Owner Furnished Items)

B. Division 40 – Process Integration

C. Section 43 41 11 – Bolted Steel Tanks

1.3 REFERENCE

A. ANSI/AWWA C651 – Disinfecting Water Mains.

B. ANSI/AWWA C652 – Disinfection of Water Storage Facilities

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 the General Conditions and Section 01 33 00, Submittals.

1.5 QUALITY ASSURANCE

A. Testing laboratory shall be 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 chemical 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: Chlorinated 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 09 90 00 - Painting and Coating

B. Section 31 23 00 – Earthwork

C. Section 31 23 17 – Trenching, Backfilling, and Compacting

D. Section 40 05 23 – Valves and Appurtenances

E. Section 40 05 75 – Piping and Equipment Identification

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 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 C110). 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 Welded and Seamless Steel Pipe for Ordinary Uses (ASTM A53), and shall be SCH 40. Steel Pipe 12 inches and larger in diameter shall be ASTM A139, AWWA C200, wall thickness not less than STD.

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 brass or stainless steel, 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 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 110) 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 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.

F. PVC pipe that appears sunburned or faded shall be rejected regardless of whether the manufacturer or supplier provides a letter stating that the pipe condition is acceptable.

2.6 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.

2.7 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.

2.8 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 and buried tubing service.

2. 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.

3. 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.

2.9 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.

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 tubing shall consist of FDA compliant HDPE or PVC with a minimum working pressure of 90 psi at 150°F. PFAS containing compounds, including PTFE will not be accepted.

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.

2.10 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.

2.11 FLANGED JOINTS

A. Flange shall conform to ANSI B16.5, Class 150.

B. 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.

C. 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.

D. Gaskets for metallic pipe and potable water service shall be NSF/ANSI-61 certified EPDM rubber, Garlock 98206 or equal.

E. 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.

2.12 FLEXIBLE SLEEVE COUPLINGS

A. Flexible sleeve couplings shall be one of the following ductile iron, long-body styles, or Engineer approved equivalent. Couplings shall be fusion bonded epoxy coated and utilize stainless steel bolts and nuts:

1. Dresser, Inc., Style 40.

2. Smith Blair, Inc., Series 442

2.13 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;

B. Couplings installed on suction piping of pumps shall have a minimum vacuum (pressure) rating of 30 inches Hg column and be of the filled arch style.

C. Flexible coupling shall have Buna N liner and cover and shall be manufactured by Proco, Red Valve Company Inc., Metraflex Company or equal.

2.14 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 C110/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.

2.15 MARKER TAPE FOR BURIED PIPING

A. Provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Provide tape with printing which most accurately indicates type of buried service. Color shall be as shown on the plans.

2.16 TRACER WIRE

A. Install insulated No. 10 solid-core copper tracer wire.

2.17 CONCRETE FOR THRUST BLOCKS

A. As specified in Section 03 30 01 – Cast-In-Place Concrete. Thrust blocks shall be used only where specifically permitted on the drawings or with pre-approval from the Engineer.

2.18 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.

2.19 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.

2.20 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 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.

3.6 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.

3.7 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 is zero.

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.

3.8 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 09 97 61 – Fusion Bonded Epoxy Linings and Coatings

C. Section 40 05 00 – Pipe and Fittings

D. Section 40 05 23 – Valves and Appurtenances

E. 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 bonded 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 performed 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. Provide cement-mortar lined and coated fittings for buried service. Provide fusion bonded epoxy lined and coated fittings for exposed service. Coating for exposed service may also conform to Section 09 90 00.

B. The pipe and specials shall be of the diameter and class shown on the drawings.

C. 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 STD for pipe larger than 10 inches diameter, except as otherwise indicated.

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. Fusion Bonded Epoxy Lining: Where indicated, fusion bonded epoxy lining shall conform to the requirements of Paragraph 2.7.

2.6 FUSION-BONDED EPOXY COATING AND LINING

A. Refer to Section 09 97 61.

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.

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, electrically actuated valves, and check valves including gate, butterfly, ball, hose bibbs, globe, check, solenoid, mud valves, vacuum breakers and flap valves.

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 BUTTERFLY VALVE ELECTRIC ACTUATORS

A. Electric actuators for open-close (non-modulating) part-turn service conforming to ANSI/AWWA C542 shall be provided where indicated on the drawings.

B. Movement over the 90° range of travel shall be uniform and require 30 seconds or longer.

C. The enclosure shall include a double layer of powder coating, have two (2) conduit connections (one for power, one for control) and be provided with a high visibility valve position indicator.

D. The motor shall be variable speed brushless rated for open/close duty with Class “F” insulation, and shall utilize a supply voltage of 120 VAC, 60 Hz.

E. Provide torque monitoring over the entire range of travel with a continuously adjustable tripping value.

F. Provide handwheel for manual operation. The handwheel shall not rotate during electrical operation.

G. Provide open/close limit switches. Switches shall be SPDT Form C type, UL listed and CSA approved, 10A at 125/250 VAC and 1/2A at 125 VDC, pre-wired to a terminal block for ease of access and limit actuator travel in both directions. The

cams for the travel switches shall be infinitely adjustable by finger touch or screwdriver.

H. All actuators shall mount directly to the valve mounting flange and stem without the need for any brackets or couplings.

I. The Actuators shall be AUMA model PROFOX PF-Q.

2.4 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.

2.5 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.

2.6 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

2.7 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.

2.8 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.

2.9 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be as described in Section 40 05 00.

2.10 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as described in Section 40 05 00.

2.11 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

2.12 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).

2.13 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.

2.14 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	Stainless steel	
Seat	EPDM	

Valves shall be Mueller 2362 or AVK series 34 with stainless steel stems and EPDM seats.

4. Type 4—Ductile-Iron Resilient Wedge Tapping Gate Valves 4 Through 16 Inches (AWWA C515):

Valves shall comply with AWWA C515 and C509 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: AVK, Mueller.

5. Type 5—Ductile-Iron Resilient Wedge Gate Valves 4 Through 36 Inches (AWWA C515 and C509):

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: AVK or Mueller.

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

Component	Material	Specification
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 stainless steel handles. 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	—
Handle	Stainless steel	

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 Fire Hydrants:

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.

5. Wet Barrel Fire Hydrants (AWWA C503):

   Refer to drawings.

6. Dry BarrelFire Hydrants (AWWA C502):

   Not applicable

7. Angle Fire Hydrants (Wharf Head Valves—AWWA C503):

   Not applicable.

E. Plug Valves:

1. Type 1 – Eccentric Plug Valves 2-1/2 through 20 inches:

   Eccentric plug valves shall be of the non-lubricated eccentric type with cast iron bodies, resilient faced plugs, or shall include replaceable, resilient seat in the body. Except as otherwise indicated, all valves for sizes 4-inch and larger shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged or grooved ends. Valves 2-1/2 inches and smaller shall have operating levers, nickel or stainless steel seats, and threaded ends with resilient facing suitable for the intended service. Submerged and buried valves shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt and water into the operator. Shaft bearings shall be stainless steel furnished with permanently-lubricated bearing surfaces. Operators shall clearly indicate valve position. Valves up to and including 20 inches in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. Eccentric plug valves shall have a pressure rating of not less than 150 psi water, oil, or gas (WOG) service and bubble-tight shut-off. Valves shall be coated per Section 09 90 00 System 7 or with fusion bonded epoxy.

F. 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.

Description	Material	Specification
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.

G. Solenoid Valves:

1. Design and construct solenoid valves such that they can be used in both horizontal and vertical piping.

2. Type 1—Metallic Solenoid Valves 1 1/2 Inches and Smaller:

Solenoid valves of sizes 1/4 through 1 1/2 inches for water and air service shall have forged brass (Alloy C23000) or bronze (ASTM B62) bodies with Teflon main seats. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel (Types 302, 304, or 305). Valve actuators shall be 120-volt a-c. Seals shall be Teflon. Valves shall have a maximum operating pressure and a maximum differential pressure of 125 psi. Valves shall be ASCO "Redhat" ,Parker Hannifin “Skinner” or equal.

H. Mud Valves

1. Type 1—Mud Valves 4 Through 24 Inches:

Mud valves shall be rising stem with flanged end, unless otherwise shown in the drawings. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron	ASTM A48 or A126
Stem, nut, disc ring, and seat ring	Bronze	ASTM B62 or B584, Alloy C83600
Extension stem	Stainless steel	AISI Type 316

Provide extension stem, stem guides, and AWWA operating nut. Mud valves shall be Clow Figure F-3088, Waterman Industries, or equal.

I. Flap Valves

1. Type 1—Flap Valves:

Flap valves shall have cast-iron body (ASTM A48 or A126) with bronze (ASTM B62) hinge pin, flap ring, and seat. Ends shall be flanged, spigot end, or hub to match the connecting pipe. Products: Clow F-3012, F-3014, F-3016; Waterous Flap Valves; Waterman Industries; 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. 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 40 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 combination pressure sustaining / pressure reducing 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)

1.4 SUBMITTALS

A. Submittals shall be in accordance with the General Conditions and Section 01 33 00.

B. Submit dimensional drawings.

C. Submit materials of construction for all valve parts including reference standard and grade. Indicate ANSI/NSF-61 certification.

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. Four (4) hours 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 MANUFACTURERS

A. Diaphragm-actuated control valves shall be manufactured by Cla-Val Company.

2.2 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.

2.3 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 valve shall have stainless steel trim (bolts, nuts, and control piping).

D. The disc shall be Buna-N rubber. The diaphragm shall be constructed of a non-wicking nylon fabric bonded with EPDM.

E. The stem, nut, spring, and fasteners shall be 304 or 316 stainless steel.

2.4 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, the same grade as the valve. Flanges shall be flat face.

C. Threaded ends shall comply with ASME B1.20.1.

2.5 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.

2.6 LIMIT SWITCHES

A. Where indicated under “Service Conditions”, limit switches shall be included with the valve.

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.

2.7 POSITION INDICATOR

A. Where indicated under “Service Conditions”, a position indicator shall be included with the valve.

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.

2.8 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.

2.9 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.

2.10 ANTI-CAVIATION TRIM

A. Where indicated under "Service Conditions", the valve shall be provided with anti-cavitation trim. Anti-cavitation trim shall also be provided 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.

2.11 VALVES

A. Class 150 Pressure-Sustaining/Reducing Valves:

1. The pressure reducing control shall respond to slight variations in downstream pressure and immediately reposition the main valve to maintain the target downstream pressure. The pressure sustaining control shall be normally held open by the upstream pressure but shall modulate should the pressure drop to the control set point. This, in turn, shall modulate the main valve to sustain the desired upstream pressure.

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.

2.12 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.

2.13 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2.14 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 epoxy coating applied in accordance with AWWA C116.

3.3 VALVE SERVICE CONDITIONS

A. Valve service conditions shall be as shown below.

B. Valve: Backwash Supply Pressure Reducing Valve with stainless steel trim

Valve Size	8 inches (Angle Pattern)
Valve Type	Pressure Reducing & Pressure Sustaining
Specific Model Number	Cla-Val 92-01 or equal
Minimum Flow	300 gpm
Maximum Flow	1,500 gpm
Upstream Pressure Range	70 - 90 psi
Downstream Pressure Range	20 – 40 psi
Anti-Cavitation Trim	Yes
Integral Flow Metering	No
Position Transmitter	No
Position Indicator	Yes
Integral Check Feature	Yes
Limit Switch	No

Initial Downstream Pressure Setting	40 psi

Initial Upstream Pressure Setting	70 psi

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

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

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 the General Conditions and 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”.

Chemical metering pumps

Non-Potable Water booster pumps
Standby generator
Carbon dioxide booster pumps

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.

3.2 INSTALLATION OF WARNING TAPE

A. Bury non-detectable tape 12 to 18 inches below ground level, directly over the utility it identifies.

B. Bury detectable tape 4 to 6 inches below ground level directly over the utility it identifies.

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 01 - Cast-in-Place Concrete

B. Section 09 90 00 – Painting and Coating

C. Section 40 05 00 – Pipe & Fittings

D. Section 40 05 23 – Valves and Appurtenances

E. Section 40 05 70 – Globe or Angle Pattern Control Valves

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 the General Conditions and 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 shall be restrained flexible sleeve type coupling or as approved by the Engineer.

END SECTION

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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) 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. 40 50 00 Instrumentation and Controls (I&C) - General Provisions
2. 40 50 01 Testing
3. 40 51 20 PLC Hardware and Software
4. 40 51 50 Control Panels and Panel Mounted Equipment

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.

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 Division 26.

1.03 SUBMITTALS

A. General submittal requirements include:

1. Refer to Division 01 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. 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.

D. 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.

E. 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.

F. 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.

G. 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. Check-offs/signoffs for each component.

      1) Tag/identification

      2) Installation

      3) Termination - wiring

4) Termination - tubing

5) Calibration/adjustment

f. Check-offs/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.

H. 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.

I. 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 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.

1.05 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 start up 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 00.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Division 01.

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.

1.07 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.

1.08 WARRANTY

A. Provide warranty per General Conditions, Warranties and Bonds, and as specified herein.

1.09 PROJECT/SITE REQUIREMENTS

A. Elevation: Equipment shall be designed to operate at the project ground elevation.

B. 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.

C. 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 Divisions 01 and 05 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 Division 26

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. 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 pH/temperature analyzers, and nitrate analyzers

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 the General Conditions and 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 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 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.

2.3 NITRATE ANALYZER

A. Nitrate analyzer shall be supplied for continuous measurement of dissolved nitrate. The nitrate monitoring system shall consist of an electronic monitor, a sampling module containing a UV absorption sensor, and associated accessories as listed below.

B. Nitrate sensor shall be a continuous-reading sensor that utilizes a 2-beam ultra-violet absorption technology with a 2 mm path length enclosed in a stainless steel probe with a cable connected to the monitor.

C. Measurement interval shall be user-selectable based upon model.

D. Sensor shall compensate for interference effects of turbidity and organic contamination.

E. Sensor shall provide reagent-free operation without the requirements of sample conditioning.

F. The sensor shall be self-cleaning via a wiper.

G. Furnish flow through cell to accommodate remote sample stream.

H. Controller shall be powered by 100-240 VAC single-phase line power. The analyzer shall provide two isolated 4-20 mA outputs as standard. Outputs shall be configurable for nitrate concentration, temperature, or PID control. Analog outputs shall be both ground isolated and isolated from each other.

I. Controller 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. Performance requirements:

1. Measurement range: 0.1 to 50 mg/L NO_2-N + NO_3-N.

2. Accuracy: ±3% of reading or ±0.5 mg/L, whichever is greater.

3. Response Time: 1 minute

4. Sampling rate: Continuous

K. The nitrate analyzer package shall be a Hach NITRATAX plus sc sensor with Hach sc200 digital controller or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Contractor shall require the manufacturer to furnish the services of qualified factory-trained servicemen to assist in the installation and calibration of the instrumentation specified herein.

B. Install each item in accordance with manufacturer's recommendations. Sensors and analyzers/transmitters that require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor.

C. All items shall be mounted and anchored using stainless steel hardware unless otherwise noted.

D. All instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown.

E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

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.

1.02 RELATED WORK

A. Refer to Section 40 50 00.

B. Section 40 51 30 Human-Machine Interface

C. Section 40 51 50 Control Panels and Panel Equipment

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. Refer to Appendix 40 50 00-C&D PLC Input/Output list for signals designated as 'Dedicated Spares.' 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. Provide Programmable Logic Controller equipment with the maximum memory available from the manufacturer for functional capacity (logic programming) to perform the specified sequence of operation with the scheduled input and output points.

B. Processor Systems shall include processor, memory cards, power supplies, input/output modules, communication modules, redundancy modules, and remote interface modules as required to satisfy system requirements.

C. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

D. All equipment and devices, furnished hereunder, shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.

E. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory and resume normal operation without manually resetting when power is restored.

F. The PLCs shall communicate between the operator workstation and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the Human Machine Interface (HMI).

G. The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

H. Backup Processor Systems shall consist of two chassis with power supplies, each containing a processor, redundancy module and communications module(s). Remote chassis shall be provided with communication modules to meet I/O and communication requirements.

I. Remote Input/Output Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.

J. Agency and environmental specifications:

1. Electrical supply voltage to the PLC shall be 120 Vac, plus or minus .15 percent, 48-63Hz. PLC system power supplies shall be fused for overload protection.

2. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150\Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:

   a. Installed rating: DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and

   b. Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.

   c. In compliance with IEC 60068 and IEC 61131.

3. Shock: 15G, 11 msec. The method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.

4. Temperature: All PLC hardware shall operate at an ambient temperature of 0 to +55 degrees C (+32 to +140 degrees F), with a storage ambient temperature rating of -25 to +70 degrees C (-40 to +185 degrees F).

5. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative humidity range of 30 percent to 95 percent non-condensing.

6. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.

7. Altitude:

   a. Operation: 0-6,500 feet

   b. Storage: 0-9,800 feet

8. Degree of protection: NEMA 1 (IP20)

9. All products shall have corrosion protection.

K. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:

1. Modules product type such as analog or digital
2. Modules catalog number
3. Modules major revision number
4. Modules minor revision number
5. Module manufacturer vendor
6. Module serial number

L. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.

M. Manufacturers

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
2. Provide the PLC system by one of the following, no others approved:
   a. Rockwell Automation Allen Bradley Compactlogix Series.

N. Central Processing Unit (CPU)

1. The CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module that solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.
2. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.
3. Supply the CPU with a battery-backed time of day clock and calendar.
4. The CPU family shall allow for user program transportability from one CPU model to another.

O. Diagnostics

1. The CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.
2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.

3. The PLC shall have indicators and on board status area to indicate the following conditions:
    a. CPU run
    b. CPU error or fault
    c. I/O failure or configuration fault.
    d. Battery good
    e. Communications indicator

P. Memory

1. The user program and data shall be contained in non-volatile battery backed memory. CPUs shall be provided with maximum available memory for logic programming storage, including on-board CPU memory and provision of available separate memory card modules.
2. Type: CMOS RAM program memory.
3. Memory Backup: lithium battery backup or Flash memory system capable of retaining all memory for a minimum of three months.
4. Backup Battery: The backup battery shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage and a low battery alarm contact.
5. Flash Memory: Upon power loss, the PLC shall transfer internal memory to flash memory before the PLC powers down.
6. The operator should be able to backup volatile memory, including data and program logic onto a personal computer storage disk.
7. The operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

Q. Programming Environment

1. Programming port: The PLC shall utilize a serial USB or Ethernet port for programming.
2. On-Line programming: Application programs may be modified or stored while theCPU is running with minimal impact on the scan time.
3. Online programming including runtime editing
4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.
5. Supply all hardware and software necessary to program the CPU in these languages.

R. Communication Ports

1. The CPU shall be expandable and supplied with additional modules to support the required communication interfaces.

S. Remote I/O Communications

1. The CPU shall be capable of communicating with up to 12 remote base locations at a combined distance of 2500 feet. The CPU shall automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
2. The communication link between the CPU and any RIO chassis shall be as recommended by the PLC manufacturer. For racks located on a link of less than 2500 cable feet, the speed of the communications link shall be greater than 230K baud with RIO scan rate of less than 5 millisecond per RIO.
3. Diagnostic and equipment status information shall be available from each RIO.
4. It shall be possible to communicate with remote I/O racks or other PLCs via fiber optic cable.
5. The remote I/O system shall have available a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU by up to 5,000 feet as detailed on the drawings.
6. Communication with the remote I/O arrangement shall be through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification section.

2.02 REDUNDANCY

A. The PLC shall be supplied with all hardware and software required to produce a completely operational redundant system if shown in the Drawings. Redundancy shall be implemented using a minimum amount of user programming. Warm backup, which is not a standard offering from the PLC manufacturer, is not acceptable.

B. The backup system shall consist of redundant controllers located in separate chassis.

C. The back-up system shall provide bump-less, transparent, switchover for system outputs. All remote I/O shall maintain their last position until either communications is re-established, or the remote I/O watchdog timer expires. Redundancy shall function regardless of which IEC 61131-3 programming languages is used for programming.

D. Switchover between the on-line PLC and the back-up PLC shall occur within 100 milliseconds if any of the following conditions occurs in the on-line unit: Power failure, CPU fault, communications module fault, or change in the on-line unit’s mode from RUN to PROGRAM.

E. The switchover shall be transparent to any devices networked to the redundant controller chassis. Transparency shall include CPU IP address switching at the hardware-level and maintaining all serial communications upon switchover between the on-line PLC and the back-up PLC.

F. The system shall automatically cross-load the primary controller’s program to the secondary controller.

G. System diagnostics and debugging tools shall be provided to assist in troubleshooting all redundancy equipment.

2.03 POWER SUPPLIES

A. The PLC shall have chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.

B. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.

C. Power supplies shall feature over-current and over-voltage protection and should be designed to operate in most industrial environments without the need for isolation transformers.

D. Power supplies shall be sized to accommodate the anticipated load plus 30%.

E. DC power supplies shall be capable of handling ripple up to 2.4V peak to peak.

F. AC Line Voltage rating of 85 to 265Vac, 47-63Hz

G. The power supplies shall allow for brown outs of at least ½ of a cycle, a harmonic rate of 10%, and will sustain continuous operation through momentary interruptions of AC line voltage of 10ms or less.

H. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power

I. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line

J. Redundant power supplies will comply with all the requirements of non-redundant power supplies in addition to the features stated below.

1. The redundant power supplies shall be designed to share the current required by the chassis. In the event of a failure of one redundant power supply, the remaining supply will accommodate the entire load of the chassis without disruption to the chassis activity.

2. Provide a failsafe fuse that is not accessible by the customer

3. Provide a solid-state relay connection to allow for failure annunciation when wired to an input module

4. Diagnostic LED status indicators for power and redundancy

2.04 CHASSIS

A. All system and signal power to the CPU and support modules shall be distributed on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.

B. All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.

C. All system modules including the processor shall be removable from the chassis or inserted in to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.

D. Modules shall be designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Electronic keying shall perform an electronic check to ensure that the physical module is consistent with what was configured.

2.05 DISCRETE INPUT AND OUTPUT MODULES

A. General

1. Selection of discrete input and output modules types shall be based on maintaining functionality and connection to existing PLC/RIO signals.
2. Digital input and output modules shall provide ON/OFF detection and actuation.
3. The I/O count and type shall be as required to implement the functions specified plus an allowance for active spares, as noted below.
4. Modules shall be designed to be installed or removed while chassis power is applied.
5. Modules shall have indicators to display the status of communication, module health and input / output devices.
6. Each module shall have the following status indicators.
    a. The On/Off state of the field device.
    b. The module's communication status.
7. I/O modules shall contain a maximum of 16 points per module.

B. Module Specifications (120Vac Isolated Input Module)

1. Nominal Input Voltage of 120V ac
2. On-State Current of 15mA @132V ac, 47-63Hz maximum
3. Maximum Off-State Voltage of 20V
4. Maximum Off-State Current of 2.5mA

C. Module Specification (120Vac Isolated Output Module)

1. Each triac type discrete output shall have an associated interposing relay located in the same control panel. 120 VAC power for relay outputs shall be provided from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
2. Output Voltage Range of 74-265V ac, 47-63Hz
3. Output Current Rating:
    a. Per Point - 2A maximum @ 30 degrees C; 1.0A maximum @ 60 degrees C; Linear Derating
    b. Per Module - 5A maximum @ 30 degrees C; 4A maximum @ 60 degrees C; Linear Derating
4. Surge Current Per Point of 20A for 43ms each, repeatable every 2s @ 60 degrees C
5. Minimum Load Current of 10mA per point
6. Maximum On-State Voltage Drop of 1.5V peak @2.0A and 6V peak @load less than 50mA
7. Maximum Off-State Leakage of 3mA per point

D. Module Specifications (Contact Output Module)

1. Output Voltage Range of 10-265V ac, 47-63Hz
2. Output Current Rating:
    a. Resistive - 2A @ 125V ac
    b. Inductive - 2A Steady State, 15A make @125V ac
3. Power Rating (Steady State) of 250VA maximum for 125V ac inductive output
4. Maximum Off-State Leakage of 0 mA per point
5. Configurable States
    a. Fault Per Point - Hold Last State, ON or OFF
    b. Program Mode Per Point - Hold Last State, ON or OFF

2.06 ANALOG INPUT AND OUTPUT MODULES

A. General

1. Selection of analog input and output modules types shall be based on maintaining functionality and connection to existing PLC/RIO signals.
2. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
3. Modules shall be designed to be installed or removed while chassis power is applied.
4. Modules shall have indicators to display the status of communication, module health and input / output devices.
5. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.
6. Analog modules shall be software configurable through the I/O configuration portion of the programming software.
7. The following status shall be capable of being examined in ladder logic
    a. Module Fault Word – Provides fault summary reporting.
    b. Channel Fault Word – Provides under-range, over-range and communications fault reporting.
    c. Channel Status Words – Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.
8. The 24 VDC power for analog instrument loops shall be provided as a part of the system. The 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. The field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.

B. Isolated Analog Input Module
   1. Input Range of 0-20 mA
   2. Resolution of approximately 16 bits across range
   3. Input Impedance of Greater than 249 Ohms
   4. Overvoltage Protection: 8V ac/dc with on-board current resistor
   5. Normal Mode Rejection of 60dB at 60Hz
   6. Common Mode Noise Rejection of 120dB at 60Hz, 100dB at 50Hz
   7. Isolation Voltage
      a. Channel to Channel - 100% tested at 1700V dc for 1s based on 250V ac
      b. User to System - 100% tested at 1700V dc for 1s based on 250V ac

C. Isolated Analog Output Current Module
   1. Output Current Range of 4 to 20 mA
   2. Current Resolution of 12 bits across 20 mA
   3. Open Circuit Detection – None
   4. Output Overvoltage Protection - 24V ac/dc maximum
   5. Output Short Circuit Protection – 20 mA or less (electronically limited)
   6. Calibration Accuracy - Better than 0.1% of range from 4mA to 20 mA
   7. Calibration Interval - 12 months typical

2.07 COMMUNICATION INTERFACES

A. The PLC will be capable of the following communication protocols as shown on the drawings:
   1. 10BASE-T/100BASE-TX Ethernet communication.
   2. Modbus (RTU and ASCII) for up to 247 slaves
   3. Profibus DP for up to 126 slaves
   4. Rockwell Automation’s RIO Protocol
   5. DeviceNet
   6. Asynchronous serial link capable of communicating up to 19.2Kbps

B. When required provide a Communications Interface Module mounted in the chassis or the equivalent port directly on the CPU.

2.08 PLC SOFTWARE

A. The PCSS shall provide a PLC configuration and application development software package complete with documentation and disks. The PLC software package and associated licensing and/or activation shall be installed on the computers shown on the drawings.

B. The software package shall allow on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.

C. All required hardware (including cables, cable adapters, etc.) for connection to PLCs shall be furnished.

D. All software licenses required to achieve the functionality described in the Specifications shall be provided.

E. The software package shall include a software license agreement allowing the Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project.

F. The software provided shall be capable of the following IEC 61131-3 functions:

1. Ladder logic.
2. Function block.
3. Sequential function chart.
4. Structure text.

G. In addition to the above editors, an add-on instruction editor shall work with any of the above-mentioned editors to create custom reusable function blocks. This software shall allow any of the derived function blocks to be modified on-line.

H. The software shall be Microsoft Windows-based and run on the supplied computers.

I. The software shall include a security feature to prevent unauthorized personnel from modifying and downloading the programs.

J. Provide an I/O simulator that allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

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 then 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

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 a SCADA software solution into service for this particular site.

1.02 RELATED WORK

A. Refer to Section 40 50 00.

1.03 SUBMITTALS

A. Refer to Section 40 50 00.

B. Remote Alarm Database:

1. After development of the SCADA system database but before system start up, provide a list of points configured for alarming and submit to the OWNER and the ENGINEER. The OWNER/ENGINEER will identify critical alarms for use in the extended alarming system and provide response descriptions.

C. Alarm descriptions shall be of sufficient detail for an accurate review by the OWNER.

D. After all shop drawings submittals required herein, have been favorably reviewed by the ENGINEER, the PCCS shall submit the following items, which must also be favorably reviewed and implemented prior to the start of system testing, the entire control system including all required software packages must be operational prior to the required Factory Acceptance Test:

1. All operator interface display submittals shall be in full color as they will appear on the display screen:

a. This submittal shall be prepared after the requisite Graphics Meetings. b. The submittal shall include:

1) Graphic displays.

2) Trend displays.

3) Alpha numeric displays.

4) Alarm displays.

2. Each display shall be uniquely titled:

a. a. Locations for process data shall be clearly identified either through the use of simulated data or by showing variables on the displays and providing a reference list describing those variables.

b. All dynamic points shall be identified by tag number as a minimum and their operation shall be described on separate sheets:

1) Color change.

2) Symbol change.

c. Three sets of submittals, with screen prints in color on a white background, are required for review by the OWNER and ENGINEER.

d. One set will be returned with comments.

3. All periodic and custom reports for the entire control system:

a. Locations for process data shall be clearly identified, either through the use of simulated data or by showing variables on the report and providing

b. reference list describing those variables.

c. Three sets of reports shall be submitted for review by the ENGINEER.

E. Operator's Reference Manual:

1. The Contractor will coordinate with the PCCS to prepare and submit a user reference manual for the operator interface system for use by the operators. This manual shall be bound in a three-ring D-ring binder and meet the following minimum requirements:

a. An index to the manual.

b. A list of operator interface:

1) Display screens.

2) Trends.

3) Reports.

4) With display name and description.

c. A summary of all possible commands and operator inputs to these screens including set points:

1) All control actions shall be included.

d. A Control System Block Diagram with names and locations of major components.

e. Instructions for manually printing screens or reports.

1) Real time.

2) Historical.

f. A summary of security levels and their privileges and limitations.

g. Spaces for operators to make notes.

2. A copy of this manual shall be provided to each operator during training on the operator interface operations:

a. The training class shall include a review of this manual with the operators in addition to more detailed instruction on the operator interface configuration and its use.

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. SCADA System Node Descriptors:

1. SCADA Client/Site Workstation: Client workstations shall be provided with all graphic display and related software for interacting with the SCADA system data. SCADA client displays shall operate on data maintained by the SCADA server. Display capabilities shall include, but not be limited to:

   a. Process mimic displays.

   b. Real time and historical trend displays.

   c. Alarm summary and sub-summary displays.

   d. System utilities.

2. SCADA Development Node: Provide the SCADA system development node with software and licenses required to edit the programs and configuration files as part of the system application development. Unless otherwise indicated, the development node shall be complete with run time software for fully testing the application programs. Functions required at the development node include:

   a. Edit the SCADA database.

   b. Edit graphic displays.

   c. Modify alarm files.

   d. Modify programs and scripts executing at any of the workstations.

   e. Set up trends and historical displays.

   f. Edit user authorizations.

   g. Other functions as may be required to modify the SCADA system application software.

3. SCADA Server: Provide Server nodes with software and licenses as needed to communicate with the PLCs and other data providers and maintain a real time database of system values. Unless otherwise indicated, server nodes shall be equipped with client software for the viewing of the real time data. The SCADA server will include input/output drivers for interfacing with field devices, and buffer historical data, and provide data for the Historian Node(s). On systems not containing a historian node, the SCADA servers shall maintain permanent data files containing the historical data.

4. Historian Node: The Historian node collects real time data and compresses the values into historical records for trending and reporting. Unless otherwise indicated, the Historian node shall archive data provided by the SCADA server. The server shall be provided with software for interfacing with standard report software packages via MS-SQL, ODBC and other standard interfaces as described in this Section.

5. Alarm Node: Each client workstation is equipped with an alarm window on the operator display with local annunciation. Where a separate alarm node has been

indicated, this node shall handle the interface to telephone, paging and radio alarming systems.

B. General:

1. The CONTRACTOR shall provide SCADA software, as required for a complete and functional SCADA system as shown on the Drawings as described in this Section:

a. System Configuration:

1) The system shall consist of a primary and backup control/data server configured for hot failover operation. Server nodes shall be equipped with I/O drivers to communicate with networked PLCs.

2) Servers shall obtain real time data from the PLC system. The servers shall monitor PLC network, PLC equipment status, and other control/data servers and re-establish data connections with a new (backup) server in case the primary server fails.

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. AVEVA Wonderware per the District’s standard.

2.02 GENERAL REQUIREMENTS

A. The operator interface software, herein described as the HMI (Human Machine Interface), shall be an integrated package for developing and running automation applications. The HMI shall be designed for use in Microsoft®, Windows 7, Windows 8, Windows 8.1, and Windows 10, as well as Windows Server 2008 R2, Windows Server 2012 Standard and R2, and Windows Server 2016. It shall use COM, ODBC, OPC, and ActiveX technologies for optimal performance and integration with other software systems.

PART 3 - EXECUTION

N/A

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.

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 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 and the General Conditions.

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 liquid filled unless otherwise noted.

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. Not used

2.4 PRESSURE TRANSMITTERS

A. Pressure transmitter shall be solid-state pressure sensor with 316L isolating diaphragm. Transmitter shall include LCD display for process measurement and diagnostic messages.

B. Accuracy shall be ±0.05% 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 1/4-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 range shall be 0 to 15 psid.

I. Differential pressure transducers shall be Endress Hauser Deltabar M PMD55. Gauge pressure transducers shall be Endress Hauser Cerabar M PMC51.

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

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.

B. The control functions described in this section are in addition to any control functions described elsewhere on the plans or specifications.

C. All analog instruments shall include the following operator adjustable alarms:

1. Instrument fail
2. High-high
3. High
4. Low
5. Low-low

D. All software control functions shall include adjustable timer delays.

1.2 RELATED WORK

A. All 40 50 XX and 40 51 XX series instrumentation and controls related specifications

B. GAC Systems (Owner Furnished)

C. Carbon Dioxide System (Owner Furnished)

D. 40 50 30 Water Quality Analyzers

E. 40 91 30 Process Pressure and Level Instruments

F. 46 33 44 Peristaltic Chemical Feed Pumps

PART 2 CONTROL LOOP DESCRIPTIONS

2.1 MISCELANEOUS

A. The control hardware, software, and programming currently in place to control the four wells, blending station, zone 2 booster pumps, existing chemical feed systems, existing water quality analyzers, and related facilities will remain in place at the conclusion of the project subject to the modifications described elsewhere in this specification. The existing PLC shall be identified as the “Conejo Plant PLC”. The Conejo Plant HMI screens shall be updated to reflect the new GAC treatment facilities and process flow.

B. New facilities including the GAC skids, carbon dioxide system, sodium hydroxide feed system, pH analyzers, nitrate analyzer, generator and ATS, backwash tank, and non-potable water booster pumps shall be integrated into a new PLC and HMI (“GAC System PLC”) located within the GAC Control Building.

C. All controls and telemetry associated with the GAC System PLC shall be integrated into the Conejo Plant PLC and the District’s SCADA system so that all functionality is available from either HMI and the District’s remote SCADA workstation.

2.2 WELL PUMP VFD OPERATION

A. The Conejo Plant PLC programming shall be modified to allow the operator to utilize the new well pump VFDs to operate the well pumps in a flow control mode. The operator shall be able to select whether each well pump is operated at constant full speed or at variable speed to achieve the operator adjustable flow target.

B. When in flow control mode, the well pump speed shall automatically vary to maintain a preset flow reading at the well discharge flow meter.

C. The operator shall be able to establish a minimum speed (Hz) for each well pump.

2.3 GAC SYSTEM MONITORING

A. Each GAC vessel will be equipped with a flow meter. The flow measurements from each vessel shall be integrated into SCADA.

B. A single differential pressure transducer will monitor the differential pressure across the GAC system influent and effluent manifolds. The differential pressure measurement shall be integrated into SCADA.

2.4 GAC SKID CONTROL

A. Each two-vessel GAC skid shall be equipped with two contractor-furnished and installed motor operated valves located on the skid outlet and backwash connections. The motor operated valves serve two functions:

1. To adjust the number of GAC skids in service based on the flow rate supplied by the wells.

2. To re-direct treated water from any skid to the backwash tank instead of the treated water tank when selected by the operator.

B. The GAC System HMI shall provide the operator with two GAC operational modes:

1. When in manual mode, the operator shall be able to manually enable and disable individual GAC skids via operation of their outlet manifold motor operated valves.

2. When in automatic mode, the control system shall automatically enable and disable available GAC skids based on operator adjustable flow rate set-points for 1-skid, 2-skid, and 3-skid operation.

a. When wells are called on, the number of GAC skids placed into service based on the totalized flow rate setpoints for all active wells.

b. One skid shall be in operation at flows less than an operator adjustable setpoint “S1” (initially set at 780 gpm).

c. Two skids shall be in operation at flows between S1 and an operator adjustable setpoint “S2” (initially set at 1,560 gpm).

d. Three skids shall be in operation at flows above S2.

e. The number of skids in service will vary in real time as the totalized flow from the wells varies.

f. The control system shall rotate between the skids each time a flow step occurs so that the same skids are not always in service at flows below S2

C. The GAC system control panel shall provide the operator with the ability to:

1. Manually select whether the treated water from each skid is directed to the treated water tank or the backwash tank.

2. Automatically direct off-line skids to waste for an adjustable time period by closing the skid effluent motor operated valve and then opening the skid backwash outlet motor operated valve. Following the flush to waste period, the backwash motor operated valve shall close and the effluent motor operated valve shall open.

D. The position of the motor operated valves will be monitored via position switches. The position status of all six valves shall be integrated into SCADA.

2.5 TREATED WATER STORAGE TANK

A. The existing treated water storage tank level-sensing pressure transducer shall be replaced with a new instrument after the tank has been replaced. The existing Plant PLC control logic shall be modified to account for the 8-foot increase in tank height and corresponding increase in tank volume.

B. The treated water storage tank will include an access hatch intrusion switch which shall activate a SCADA alarm.

2.6 BACKWASH TANK

A. The backwash tank will be equipped with an ultrasonic level transducer for monitoring the water level in the tank.

1. The tank level shall be displayed at the GAC System and Plant HMIs and via SCADA.

2. Operation of the non-potable water pumps shall be inhibited if the water level in the backwash tank reaches an operator adjustable low-low level (initially set at 5 feet).

3. A SCADA alarm shall be generated if the water level in the tank reaches an operator adjustable high level (initially set at 18 feet).

4. The well pumps, if on, shall be disabled if the tank reaches an operator adjustable high-high level (initially set at 20 feet).

2.7 NON-POTABLE WATER BOOSTER PUMP STATION

A. The two non-potable water booster pumps shall operate in a duty/standby configuration with the duty pump alternated each time the pump station is activated.

B. The pump station shall operate in manual and automatic modes

1. In manual mode the duty pump shall be started by the operator and shall shut off either manually or when an operator adjustable low water level in the tank has been reached.

2. In automatic mode the PLC shall control the speed of the duty pump to maintain an operator adjustable backwash tank water level value.

C. Each pump is equipped with a flow meter that shall be monitored by the GAC PLC. Operation of non-potable booster pumps shall be inhibited and an alarm generated if no flow is detected by the flowmeter associated with an operational pump.

2.8 CARBON DIOXIDE STORAGE AND FEED SYSTEM

A. The GAC System PLC shall mirror all control functions and telemetry provided by the Owner-furnished carbon dioxide storage and feed system

B. The system shall provide two modes of operation:

1. “AUTO” Control Mode: In AUTO control mode, the carbon dioxide system shall adjust the carbon dioxide feed rate based on a 4-20mA signal from the GAC System PLC, which shall be based on a compound loop incorporating the totalized flow from the wells supplying the GAC treatment plant and the pH level measured by the GAC system influent pH analyzer.

2. "MANUAL" Control Mode: In manual control mode, the carbon dioxide system controller will have primary control over the feed rate. The feed rate shall be controlled based on an operator adjustable CO2 flow rate in pounds per hour.

3. The following carbon dioxide system telemetry signals shall be integrated into the GAC System PLC:

   a. CO2 skid control panel HOA status

   b. CO2 storage tank high and low pressure alarm status

   c. CO2 flow rate

   d. Carrier water low pressure alarm

   e. Carrier water flow rate

2.9 SODIUM HYDROXIDE STORAGE AND FEED SYSTEM

A. The chemical level in the sodium hydroxide storage tank shall be monitored using an ultrasonic level transducer.

B. The two sodium hydroxide metering pumps shall be operated in a duty/standby configuration with the duty pump alternated each time the system starts.

C. The operator shall be able to select between two operational modes: flow paced and compound loop.

   1. When in flow-paced mode, the dosage of sodium hydroxide shall be input by the operator (in mg/L) and the feed rate adjusted based on the totalized flow of the wells that are active.

   2. When compound loop control is enabled, the PLC shall utilize the GAC System effluent pH analyzer signal to trim the flow-paced chemical dosage rate to achieve an operator input pH target.

D. The sodium hydroxide storage tank will be equipped with a heater. The tank heater is local control only and will not need to be integrated into the SCADA system.

END SECTION

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SECTION 43 21 52

VERTICAL TURBINE BOOSTER PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, testing, and installation of product lubricated vertical turbine pumps in suction barrels for non-potable clear liquid service.

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 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 the General Conditions and 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.

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 ANSI/HI 14.6.

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.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Pumps and appurtenances shall be 4-stage 12JKM manufactured by Trillium, or equivalent 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	Non-Potable Water Booster Pump
Tag Numbers	NPW-1, 2
Location	Outdoors
Elevation	300 ft
Design Flow (GPM)	1,000
Design TDH	230
Minimum Flow (when using VFD)	350 gpm
Minimum TDH (when using VFD)	N/A
Maximum RPM at Design Conditions	1,800
Minimum Bowl Efficiency at Design Flow/TDH	80%
Motor HP	100
Motor Type (Solid/Hollow Shaft)	Solid Shaft
Variable Speed	Yes
Minimum NPSHA (at eye of bottom impeller)	32 ft
Pump Lubrication (Water/Oil)	Water Lubricated
Column Pipe (Flanged/Threaded)	Flanged

Discharge Head (Cast/Fabricated)	Fabricated
Seal (Mechanical/Packing/Oil Lubricated)	Mechanical

Secondary Design Conditions		
Flow	**Total Head**	**Minimum Efficiency (%)**
0	320	NA
500	310	68
1400	120	65

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) or 316 stainless steel.
Bowl Assembly Shaft	416 SS - (ASTM A582 Type 416)
Bowl Bearings	Bronze - (ASTM B505 Alloy 932) or Bismuth Tin Bronze (UNS C89835)
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	None required.

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)
Discharge Head (Cast)	Cast Iron – (ASTM A48 cl 30)
Barrel	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 bell. 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. Flanged 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”.

C. 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.

D. 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.

E. 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.

F. 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. 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 stainless steel or from 1/2 inch mesh expanded metal. Each guard shall be designed for easy installation and removal. Guards shall be hinged with a hasp mechanism used to secure the cover in the closed position. All necessary supports and accessories shall be provided for each guard.

C. 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).

D. 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.

E. 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.

2.9 MOTOR

A. Pump shall be driven by a vertical solid shaft type electric motor as specified under “Service Conditions”.

B. Motors shall be suitable for continuous operation on a three-phase 60-hertz 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. The motor shall be equipped with thermal overload switches, one per phase, 140 C, normally closed.

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. 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 Underwriters Laboratories (UL) recognized.

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.

2.10 BARRELS

A. For barrel (can type) pumps, each pump barrel shall be of the ANSI/HI-9.8 length design and size recommended by the manufacturer and shall conform to Hydraulic Institute Standards. Barrel inlet nozzle and flange shall be located and sized properly per ANSI/HI9.8 standard. Pump barrel (can) must be designed in such a manner as to prevent submerged vortices from being developed. The barrel's top mounting plate shall be of sufficient thickness to drill and tap for ANSI rated flange bolting to match the base flange of the discharge head. The top mounting plate of the barrel shall be properly machined and be gasketed or "O" ringed for a zero leakage connection to the discharge head. The pressure rating of the barrel shall be capable of containing the maximum suction pressure. Each pump barrel shall be vented. The pumping system shall be designed to be supported from the base of the can.

B. If recommended by HI the suction barrel shall be fitted with 2 direction vanes to reduce hydraulic swirling. They should be welded to the inside of the barrel in line with the suction centerline and located 180 degrees apart.

2.11 FACTORY COATING

A. The bowl assembly OD and discharge head ID shall be factory painted with a 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.

B. Exterior surfaces of the discharge head, barrel, 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 TANKS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Design, fabrication and erection of a ground supported flat-bottom, anchored, treated water and backwash bolted steel water storage tanks in accordance with AWWA D103, including Section 12 for seismic design.

B. Tank appurtenances as described herein.

C. Design of the tank, ring-wall, and anchorage.

1.2 RELATED SECTIONS

A. Section 03 30 01 - Cast in Place Concrete

B. Section 13 07 00 – Seismic Requirements for Contractor Furnished Items

C. Section 31 23 00 – Earthwork

D. Section 32 11 23 – Aggregate Base

E. Section 33 13 00 – Disinfection of Water Distribution System

F. Section 40 05 00 - Pipe and Fittings

G. Section 40 05 23 - Valves and Appurtenances

H. Division 26 - Electrical

1.3 DESIGN INFORMATION

A. The tank dimensions and capacity are as follows:

Tank	Useable Volume (Gallons)	Nominal Diameter (Feet)	Max. Water Level (feet)
Treated Water	85,000	27	20
Backwash	126,000	33	20

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: 105 mph

E. Comply with AWWA D103. Alternative rules and design stresses in Section 14 may be utilized.

1.4 ADDITIONAL LOADING

A. The tanks shall be designed to independently support the tank inlet riser pipes and overflow pipes shown on the plans.

1.5 SEISMIC DESIGN

A. Refer to Specification 13 07 00 – Seismic Requirements for Contractor Furnished Items.

1.6 REFERENCES

A. AWWA D-103 Standards of the American Water Works Association

B. California Building Code

1.7 SUBMITTALS

A. Submit in conformance with Section 01 33 00 – Submittals.

B. Provide complete design calculations for tank and foundation, 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.

4. Provide coating materials list which indicates the manufacturer and the coating number, keyed to the coating schedule herein.

5. Submit Manufacturer's standard color samples.

1.8 QUALIFICATION/EXPERIENCE

A. The manufacturer shall be quality certified, having an active API-Q1 and an ISO 9001 registration.

1.9 WARRANTY

A. The tank shall be deemed accepted when it 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 01 – Cast in Place Concrete.

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.

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. 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 and outlet connections shall conform to the sizes and locations indicated on the Plans.

C. Where shown on the plans, the tank design shall incorporate a screened, air-gapped connection providing a minimum of two pipe diameters between the nozzle of the inlet pipe and the tank roof.

D. Provide other pipe connections as shown on the drawings.

E. Flush Cleanout Door: The flush cleanout door shall measure 24” x 46” and be located as shown on the Plans

F. Shell Manway: The shell manway shall be of the mono-bolt design and have a 30” opening.

G. Ladders:

1. Conform to applicable local, state and federal regulations.

2. Provide an outside ladder with galvanized Saf-T-Climb assembly and lockable ladder gate.

H. Roof guardrails shall comply with applicable local, state and federal regulations and AWWA D103. Guardrails shall extend around the entire circumference of the tank roof.

I. Provide one (1) 24” square lockable roof hatch in accordance with AWWA D103. Hinges shall be stainless steel.

J. Provide one mushroom type fiberglass roof vent with removable lid. Vent design shall conceal the screens from horizontal exposure. The vent shall be fiberglass 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 3,150 gpm.

K. Overflow: Provide a weir inlet with overflow pipe to the ground terminating in a vertical nozzle fitted with a screen and centered over an adjacent 4’ catch basin. Weir shall be designed for a flow of 3,150 gpm with a maximum, height of water above crest of 4”.

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.

2.3 COATING

A. All metal plates, supports, members, interior and exterior of all piping supplied by the tank manufacturer, and miscellaneous parts, except bolts and indicated accessories and appurtenances, shall be factory powder coated in accordance with the provisions of these specifications.

B. Interior coatings must be on the current NSF Standard 61 list for potable water coatings.

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, (including underside of the steel floor). 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 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. Furnish the Owner with a minimum of 1 gallon touch-up paint in an unopened container with manufacturer's instructions.

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.

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.

3.5 FILLING AND HYDROSTATIC TESTING

A. The tanks shall be subjected to hydrostatic testing.

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.

3.6 VOC TESTING

A. Potable water tanks shall be subjected to VOC testing.

B. 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.

C. If VOCs exceed California drinking water standards, 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

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 and wind loading 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 Section 01 33 00 .

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 manufacturer’s warranty.

F. Submit unloading procedure and installation manual.

G. Submit operation and maintenance manual.

H. Submit supporting documentation of Manufacturer’s certification to NSF/ANSI Standard 61 – Drinking Water System Components for water treatment chemicals.

I. 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 Assmann Polyethylene Tanks, Snyder Industries, Poly Processing or equal.

2.2 GENERAL

A. Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, 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.

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 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. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

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 California Building Code seismic design parameters.

B. Refer to Section 13 07 00 – Seismic Requirements for Contractor Furnished Items.

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 Tank

Chemical Service	25% - 50% Sodium Hydroxide
Double Wall	Yes
Tank Quantity	1
Location	Outdoors
Tank Volume, Min	5,000 gallons
Tank Dia, Nominal	10’
Tank Shell Height, Nominal	13’

Wind Exposure	105 mph
Level Indicator	Liquid Level Float and ultrasonic transducer per plans
Color	White/natural
Insulation	Yes
Heat Tracing	Yes (ΔT=60)
Ambient Temperature	30 – 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.

END OF SECTION

SECTION 46 33 44

PERISTALTIC CHEMICAL FEED PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes peristaltic chemical metering pumps.

1.2 RELATED WORK

A. Section 01 33 00 – Submittals

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 and the General Conditions.

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 chemical(s). 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 5 years from the date of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The peristaltic chemical metering pumps shall be Blue-White ProSeries-M. No alternatives will be considered.

2.2 GENERAL

A. Pump shall be a positive displacement, peristaltic type complete with pumphead, self contained variable speed drive, and flexible extruded tube.

B. Pump shall be capable of 24 hour continuous duty at 45 degrees C ambient temperature, capable of running in either direction, and capable of running dry without damage.

C. Pump shall be self priming with a suction lift of at least 30 feet of water.

D. Pump shall use no check valves or diaphragms and shall require no dynamic seals in contact with the liquid. The process liquid shall be contained within the pump tubing and shall not directly contact any rotary or metallic components.

E. Pump shall be designed for washdown exposure and compatible with the chemical being pumped.

2.3 PUMP HEAD

A. Pump head shall incorporate a fixed track with a removable cover, an adjustable tube retainer mechanism, and a rotor assembly.

B. Squeeze rollers with encapsulated ball bearings shall be directly coupled to a one piece thermoplastic rotor. Two or three polymeric rollers shall be provided.

C. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent back flow or siphoning. The tubing shall be in contact with the track through a minimum angle of 180 degrees and be held in place at the suction and discharge ends.

D. Tubing shall be replaceable with no disassembly of the pumphead.

E. Cover shall be positively secured to the pumphead and removable without the use of tools. Pumphead cover shall seal against the pumphead for complete leak containment.

2.4 TUBE ASSEMBLY

A. Tubing shall be furnished by the pump manufacturer.

B. Tube connections shall be constructed of PVDF or equally chemically resistant material.

C. Manufacturer shall certify that the tube material is 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.

2.5 DRIVE

A. Drive shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on any input power from 110VAC to 240VAC, 60 Hz single phase.

B. Pump drive shall be close coupled and self-aligning, requiring no flexible couplings.

C. Drive speed shall be infinitely variable.

D. Motor shall be a reversible, brushless DC gear motor rated for continuous duty. Motor shall be equipped with overload protection and limited to a maximum speed of 130 rpm.

2.6 CONTROLS

A. All control circuitry shall be integral to the pump and capable of adjusting the pump motor speed from 0.01% to 100.00% in 0.01% increments less than 1% motor speed and in 0.1% increments greater than 1% motor speed (10,000:1 turndown ratio).

B. Provide for remote stop/start signal via 24V logic or non-powered contact closure loop.

C. Provide for manual/auto and local/remote control.

D. The pump output shall be capable of being remotely controlled via 4-20mA analog input with input signal trimmable and speed scaleable over any part of the speed range.

E. The pump output shall be capable of being remotely controlled via pulse triggered batching. The pump shall accept a TTL/Cmos digital pulse type input and a contact closure type pulse input.

F. Provide at least two output relay contacts, NO or NC, software configurable for running/stopped status; forward/reverse status; auto/manual status; general alarm status; and leak detected status.

G. Provide 4 – 20mA speed output signal.

H. Pump shall automatically restart in the event of a power outage.

2.7 USER INTERFACE

A. Provide a graphical backlit LCD display for menu driven configuration settings, pump speed, run status, flow rate, service alerts, tube failure detection system and flow verification system (if required) alarms status.

B. Provide keypad and/or click wheel for start, stop, speed, forward/reverse, prime, and programming.

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 revolutions.

2.8 LEAK DETECTION

A. Pump shall include a leak sensor in the pumphead designed to detect failure of the tube or leakage at the tube connections.

B. Leak detection shall initiate a remote alarm and disable the pump.

2.9 FLOW VERIFICATION

A. Where indicated under SERVICE CONDITIONS provide a flow verification sensor to verify chemical injection.

B. Flow verification sensor shall be paddlewheel type sensor generating a digital pulse signal and shall be active only when the pump is running.

C. Sensor operating range shall be compatible with the range of design feed rates described under SERVICE CONDITIONS.

2.10 SERVICE CONDITIONS

A. Pumps satisfying the following service conditions shall be provided:

Tag No.	Pumped Liquid	Maximum Pumping Rate	Maximum Pressure
SHP-1, 2	25% / 50% Sodium Hydroxide	33 GPH	50 PSI

2.11 ACCESSORIES AND SPARE PARTS

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. Furnish each pump with a spare replacement tube assembly.

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.

END SECTION

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